TRAINING SCHOOL

MOTOROLA Communications and Electronics Inc.

TECHNICAL TRAINING DEPARTMENT

NATIONAL
MOTOROLA
COMMUNICATIONS
SERVICE

COURSE NO. CA 2

CLOSED CIRCUIT TELEVISION

TECHNICAL
TRAINING
DEPARTMENT

COURSE NO. CA 2

CLOSED CIRCUIT TELEVISION

TOROLA COMMUNICATIONS AND ELECTRONICS INC. A SUBSIDIARY OF MOTOROLA, INC.

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80 Mc BANDWIDTH

RESOLUTION - AMOUNT of detail

THE 1140 CAMERA HAS RESOLUTION of 800 LINES

$60^{1/2}$ PICTURES A SEC.

INTERLACED SCANNING PUTS 1/2 of PICTURE ON AT A TIME TAKES EVERY OTHER LINE.

~~Cuts~~ REASON for INTERLACED SCANNING - REDUCES BANDWIDTH.

LOCKED INTERLACED - EXACT DIVISIONS ON HOR + VERT FREQ.

RANDOM INTERLACED - NO EXACT DIVISIONS. VERT - LINE FREQ - HOR. - CRYSTAL OSC. 15,750 N

PICTURE TUBE.

800 TO 100 V DRIVE MAX

G1 = INTENSITY

G2+4 - BEEM forming

VIDICON

GRID 1 - INTENSITY

GRID 2 } ACCELATION
GRID 3

GRID 4 DECELLERATION

QUALITY AREA ON VIDICON $3/8 \times 1/2$" OR
3 TO 4

MOST TIME DC RESTORER IN

2 OR MORE CAMERAS SWITCHING DC RESTORER
OUT TO EVEN OUT changes in Cameras

1" Lens	22°	HOR
2" Lens	14°	"
3" Lens	9½°	"

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CA2-I
TECHNICAL TRAINING DEPARTMENT

PART I – INTRODUCTION

The material covered in this course is designed to be adapted to the needs of the MSS technicians.

The course outline on basic CCTV fundamentals in this book extends over a period of 13-1/2 hours. However, the instructor should determine how much time should be devoted to this portion of the school, based on what is practical and what are the needs of the students in the class.

For example; if the book material cannot be covered in one day or one evening session, it would be desirable to plan on several sessions (day or evening) until the course material is adequately covered.

Also included in this school package are sections discussing Locked Interlace Scanning and The Wobbulator.

Since the applications for locked interlace scanning are not extensive, little information on the subject has been available to the technician in the past. For this reason, a section covering locked interlace has been included in this course.

A special section has been incorporated into this school package covering The Wobbulator, a relatively low-cost piece of test equipment used to adjust the camera vidicon beam for best resolution. Alignment procedures using The Wobbulator, a schematic diagram of the circuit and a parts list for building the unit comprise this section. Pictures showing its proper use and a typically constructed unit are included.

Four instruction manuals are included in this course package covering: Model S1140A Transistorized Camera; Model S1219A Transistorized Monitor; Model S1239A Gate Watch Control Console and Model S1238A Area Surveillance Control Console. Detailed curricula are to be found in Part II, Sections B and C, respectively, for the aforementioned Camera and Monitor. The two control console manuals, however, are included for reference only and hence, do not have curricula.

NOTE TO THE INSTRUCTOR:

In those situations where the instructor finds it appropriate, the instruction manual for Model S1120C Transistorized Camera may be ordered from the Engineering Publications Department, Chicago office, and substituted for the S1140A Transistorized Camera manual. (For number of Model S1120C camera instruction manual see PART VI, SECTION I.) A detailed curriculum for the Model S1120C camera will be found in PART II, SECTION D. The slides for this unit are to be found in Tray 2 of the CA2 slide package.

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CA2-II
TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION...

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PART II – COURSE OUTLINE A

NOTE: All references in this section of the course outline refer to pages found in Part VI – Section A – Fundamentals – Closed Circuit Television ... Operation and Maintenance.

TIME		REFERENCES	SLIDES
	SECTION I. INTRODUCTION	P. I-1, 2	
3/4 Hr. Total	**SECTION II. TV SYSTEM**	P. II-1-7	
15 Min.	A. SIMPLE SYSTEM	P. II-1, 2 Fig. 1	2
10 Min.	B. SPLIT AMPLIFIER	P. II-2 Fig. 2	3
10 Min.	C. DEFLECTION	P. II-5 Fig. 6, 7	8, 9
10 Min.	D. SYNC.	P. II-6, 7 Fig. 8	10
1 Hr. Total	**SECTION III. PICTURE TUBE**	P. III-1, 2	
	A. DIAGRAM		
10 Min.	1. Screen	P. III-1 Fig. 9	11
10 Min.	2. Electron Gun	P. III-2, Fig. 9	11
	B. FUNCTION OF ELEMENTS		
10 Min.	1. Beam Formation	P. III-2 Fig. 9	11
10 Min.	2. Acceleration	P. III-2 Fig. 9	11
10 Min.	3. Focus - Magnetic	P. III-2 Fig. 9	11
10 Min.	4. Focus - Electrostatic	P. III-2 Fig. 9	11

TIME		REFERENCES	SLIDES
1-1/2 Hrs. Total	**SECTION IV. INTERLACED SCANNING**	P. II-2-4 P. XII-1	
	A. DEFINITION OF INTERLACED SCANNING	P. II-2-4 Fig. 3, 4, 5 P. XII-1 Fig. 25	4, 5, 6 7
	B. REASONS FOR USING		
15 Min.	1. Flicker	P. XII-1	
15 Min.	2. Bandwidth	P. XII-1	
	C. RANDOM INTERLACE AND LOCKED INTERLACE		
10 Min.	1. Two to One Relationship	P. XII-1	
10 Min.	2. Exact One Half Line Start and Finish	P. XII-1	
10 Min.	3. Perfect Interlace	P. XII-1	
15 Min.	4. Perfect Pairing	P. XII-1	
15 Min.	5. Relative Resolution of Two	P. XII-1	
30 Min. Total	**SECTION V. DEFLECTION**	P. IV-1-3	
10 Min.	A. EFFECT OF MAGNETIC FIELD	P. IV-1 Fig. 10	12
10 Min.	B. COIL PHYSICAL ORIENTATION	P. IV-1, 2 Fig. 10	12
10 Min.	C. WAVE FORMS REQUIRED	P. IV-1, 2 Fig. 11	13
1/2 Hr. Total	**SECTION VI. SAW– TOOTH GENERATION**	P. V-1-4	
15 Min.	A. RC TIME CONSTANTS	P. V-1, 2 Fig. 13	15
15 Min.	B. RC WITH SWITCH	P. V-2, 3 Fig. 13	15
1 Hr. Total	**SECTION VII. MULTIVIBRATORS AND BLOCKING OSCILLATORS**	P. VI-1-4	
15 Min.	A. TRANSISTOR SWITCH	P. VI-1 Fig. 15	17
15 Min.	B. TUBE MULTIVIBRATORS	P. VI-1, 2, 3 Fig. 16	18
15 Min.	C. BLOCKING OSCILLATORS	P. VI-3, 4 Fig. 17	19

TIME		REFERENCES	SLIDES
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20 Min.	2. Function of Elements	P. VII-2, 3, 4 Fig. 18	20
10 Min.	3. Deflection	P. VII-3 Fig. 18	20
10 Min.	4. Focus	P. VII-2 Fig. 18	20
	B. VIDEO SIGNAL		
20 Min.	1. How Developed	P. VII-3, 4 Fig. 18	20
10 Min.	2. Video Load	P. VII-3, 4 Fig. 18	20
15 Min.	C. DARK CURRENT	P. VII-3 Fig. 18	20
15 Min.	D. SIGNAL POLARITY	P. VII-3 Fig. 18	20
	E. TARGET AND BEAM		
15 Min.	1. Settings	P. VII-4 Fig. 18	20
20 Min.	2. Effects of Wrong Settings	P. VII-4, 5 Fig. 18	20
	F. CARE		
15 Min.	1. Burns	P. VII-4 Fig. 18	20
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3/4 Hr. Total	**SECTION X. SYNC. AND BLANKING ADDITION**	P. IX-1-4	
10 Min.	A. RC	P. IX-1, 2 Fig. 20	22
10 Min.	B. DIODE	P. IX-1, 2 Fig. 20	22
10 Min.	C. TRANSISTOR	P. IX-1, 2 Fig. 20	22
15 Min.	D. WAVE FORMS	P. IX-2, 3 Fig. 21, 22	23, 24

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5 Min.	B. SYNC. CHANNEL	P. X-1	
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15 Min.	A. CHARACTERISTICS	P. XIV-1, 2	
15 Min.	B. LENGTH	P. XIV-2	
1/4 Hr. Total	**SECTION XIII. CLOSED CIRCUIT TELEVISION STANDARDS**	P. XIII-1, 2	
1-3/4 Hrs. Total	**SECTION XIV. LENSES AND LIGHTING**	P. XV-1, 2 & Insert	
10 Min.	A. GENERAL	P. XV-1, 2	
	B. OPTICS AND LIGHTING	Pages following P. XV-2 (A guide to lenses and lighting for CCTV systems - E-355)	
5 Min.	1. What the camera can see		
15 Min.	2. Make certain there is enough light		
10 Min.	3. Motorola lenses		
5 Min.	4. The lens stop		
10 Min.	5. F/Stop settings		

TIME		REFERENCES	SLIDES
	C. SELECTING THE CORRECT LENS		
10 Min.	1. Magnification		
15 Min.	2. Depth of field of a lens		
5 Min.	3. Depth of field of the scene		
5 Min.	4. Depth of field data		
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5 Min.	1. Finalizing depth of field		
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PART II – COURSE OUTLINE B

NOTE: All references in this section of the course outline refer to the Motorola Model S1140A Transistorized Television Camera as outlined in manual No. 68P81048A90-O Page numbers refer to the above mentioned manual.

	REFERENCES	SLIDES
SECTION I. CAMERA BLOCK DIAGRAM	P.8	33
SECTION II. VIDEO AMPLIFIER	P.13,14,16	
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B. 2ND VIDEO AMPLIFIER (Q2) & HIGH PEAKING ADJUSTMENT	P.13	34
C. 3RD VIDEO AMPLIFIER (Q5)	P.13	35
D. 4TH VIDEO AMPLIFIER (Q6) & VIDEO GAIN CONTROL (R36)	P.13	36
E. CLAMP DRIVER (Q9)	P.13	36
F. KEYED CLAMP (Q10)	P.13	36
G. INVERTER (Q11), CLIPPING DIODE (CR7) & SETUP CONTROL (R26)	P.13	37
H. DRIVER (Q12)	P.13	37
I. VIDEO OUTPUT (Q13)	P.13	38

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PART II – COURSE OUTLINE C

NOTE: All references in this section of the course outline refer to the Motorola Model S1219A Transistorized Video Monitor as outlined in manual No.68P81039A25-B. Page numbers refer to the above mentioned manual.

	REFERENCES	SLIDES
SECTION I. MONITOR BLOCK DIAGRAM	P.5	63
SECTION II. VIDEO AMPLIFIER	P.4, 6, 7	
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2. Termination Switch	P.4	64
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D. DRIVER (Q4)	P.4	67
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1. D.C. Restoration Switch	P.6	67
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3. Arc Suppressors	---	67
F. SYNC. AMPLIFIER & CLIPPER (Q6)	P.6	68

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PART II – COURSE OUTLINE D

NOTE: All references in this section of the course outline refer to the Motorola Model S1120C Transistorized Television Camera as outlined in Manual No. 68P81036A10-B, schematic No. 63E81036A11-B. Page numbers refer to the above mentioned manual.

	REFERENCES	SLIDES
SECTION I. CAMERA BLOCK DIAGRAM	P.9	7
SECTION II. VIDEO AMPLIFIER	P.15	--
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B. AMPLIFIER (Q102)	P.15	8
C. BUFFER (Q103)	P.15	8
D. AMPLIFIER (Q104) & HI PEAKING CIRCUIT	P.15	9
E. APERTURE CORRECTION CIRCUIT (Q105)	P.15	9
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2. Aperature Balance Control	P.15	9
F. BUFFER (Q106)	P.15	10
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CLOSED CIRCUIT TELEVISION...

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B. TRANSISTORIZED CAMERA (MODEL S1140 A)

C. MOTOROLA 19" VIDEO MONITOR (MODEL S1219A)

D. TRANSISTORIZED CAMERA (MODEL S1120C)

E. SUGGESTED TEST EQUIPMENT

1. D. C. MULTIMETER - S1063A
2. OSCILLOSCOPE - T1014B WITH ACCESSORY PROBE TEKA-22
3. CAMERA ALIGNMENT JIG - TECHNICAL TRAINING DEPT. MODEL
4. VARIABLE TRANSFORMER - MOTOROLA PART NO. 25A82568G02
5. RETMA RESOLUTION CHART 1956 - SCHEMATIC NO. 63E862922-A
6. 1" CAMERA LENS
7. WOBBULATOR - SEE PART VI., SECTION H

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9. Amplifier and Aperature Correction Schematic
10. Buffer, Amplifier, Buffer and Gain Control Schematic
11. Buffer and Inverter Schematic
12. Output Driver and Video Output Schematic
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21. Vertical Oscillator and Vertical Sawtooth Amplifier Schematic
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PART V. CLOSED CIRCUIT TELEVISION DEFINITIONS

The following definitions of closed circuit terms are those that have been agreed on by the Electronics Industries Association (EIA). More terms could be added to this list and it is possible that some of the definitions may change in the future. However, this list represents the best available at this time.

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COURSE No. CA 2
PART VI

TEXT

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CA2-VI-A

TECHNICAL TRAINING DEPARTMENT

PART VI – SECTION A

FUNDAMENTALS CLOSED CIRCUIT TELEVISION... OPERATION AND MAINTENANCE

I. INTRODUCTION

To the average two-way radio service technician television is looked upon as a common commodity for use by the general public to supply home entertainment.

Perhaps his experience has been limited only to enjoying broadcast television of sports events, motion pictures, stage shows, political debates and other entertaining programs. In some instances the radio technician may have a closer association with television, in that he has been, or is servicing the common type of entertainment television receiver. And yet, he has given but little thought, or is not aware, that an allied industrial use for television has in recent years shown an amazing increase in usage. Indeed, the entertaining type of television is only a small fraction of the potentials of television. Not only is closed circuit television applicable to industrial usage, it is used in many specialized fields, such as; public safety, medicine, surveillance, traffic, data transmission, banking, education, sales training, advertising, intercommunications, military and others.

Industrial use of translating vision to remote and inaccessible points by electrical means has made a material contribution to the growth of industry. What does all this mean to the two-way radio technician? There is a need to awaken to the fact that here is a new medium of electronics requiring his services and that he must prepare himself for the day when he is actively engaged in the service and maintenance of closed circuit television. Two-way radio is communication using only one of the senses, hearing. CCTV is communication adding another dimension, the sense of sight.

It's a fortunate fact that electronics in all its various fields bears a similarity to fundamental concepts. Therefore, even in entirely new applications the technician who is thoroughly groomed in radio fundamentals, and, particularly one who is actively engaged in servicing electronic apparatus, needs only to add some additional new knowledge to what he already knows to become qualified to service and maintain CCTV equipment.

In learning about any new medium, it is well to become fully informed about such things as terminology and usage, together with acquiring a thorough understanding of circuit functions. In the preparation of this book, an attempt has been made to provide specific information on a particular type of equipment. However, for the technician to grasp the meaning for the reasons of using closed circuit television at all, it is well to tell something of its general use and system application.

In the beginning of this book, the contents are more general than specific. As one acquires a speaking knowledge of closed circuit television fundamentals, applications, system engineering considerations, CCTV terms and system planning, the service information becomes specific and detailed to the individual units.

A list of recommended test equipment and several equipment manuals are included. For those who would like to know more about closed circuit television in general, a number of other publications are listed as reference material.

1. Basic Television: Principles and Servicing
   Second Edition McGraw-Hill Book Company, Inc.

2. Television in Science and Industry:
   John P. Wiley and Sons, Inc.

3. Educational Television Guidebook:
   McGraw-Hill Book Company, Inc.

4. Closed Circuit Television System Planning:
   John F. Rider Publisher, Inc.

It is assumed that the reader is familiar with electronic equipment servicing, tube and transistor fundamentals and the use of the specified test equipment.

II. THE TELEVISION SYSTEM

Closed circuit or broadcast television systems differ from voice communication systems in several respects. Since it is assumed that the reader is familiar with voice communications, we will concentrate on the differences between the two systems. A fundamental similarity between audio and video communication systems is that the information is sent in sequence in both systems. In audio systems, however, there is usually very little modification of the original signal from the microphone, while in video systems the signal from the camera pick-up tube is modified considerably before transmission. Also, the signal in an audio system is used to provide only an audible output while the signal in a video system is divided or separated to perform more than one function.

This discussion of closed circuit television will be limited in scope to conventional systems. Optics, illumination, coaxial cables and various accessories will be treated in large measure as being independent and unrelated to the basic considerations of the television system although they are, in fact, very much related. This approach will, however, allow us to proceed directly to parts of the system with which the television maintenance technician will be more concerned.

To begin the discussion, we will first refer to a basic block diagram (Figure 1).

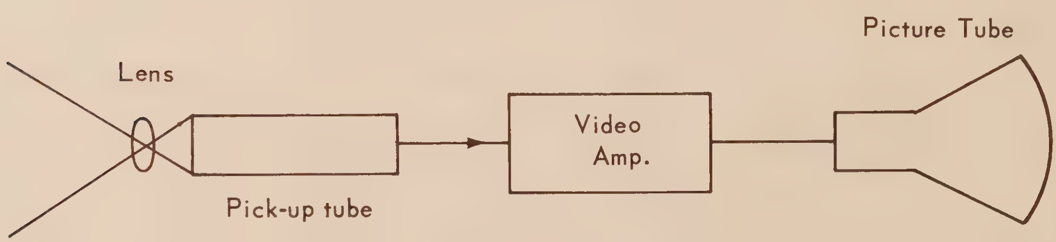


Figure 1

This basic diagram indicates the signal path of the video information from the pick-up tube through the video amplifier to the picture tube. The picture tube displays the image that is projected through the lens onto the photosensitive surface of the pick-up tube.

In practice, the video amplifier is divided into 2 parts – 1 located in the camera and the other located in the monitor.

Figure 2 indicates this separation which is done in order to provide amplification before transmission over the relatively long cable connecting the camera and monitor.

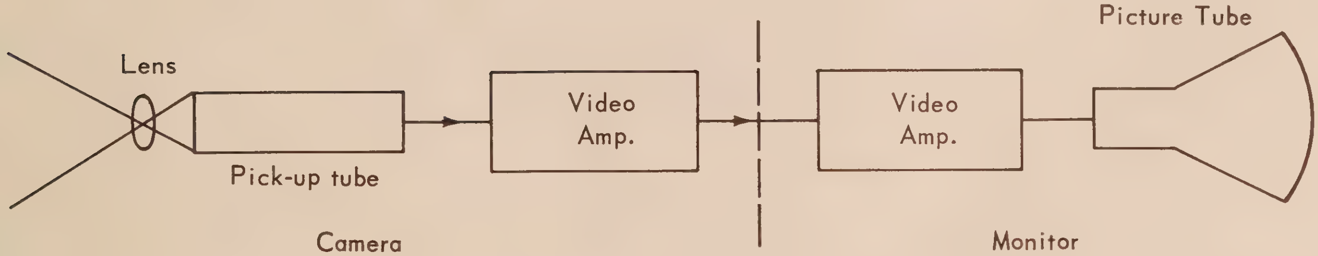


Figure 2

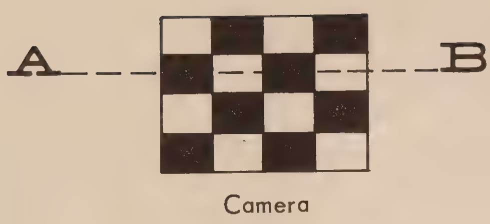
The block diagram of Figure 2 shows the signal path of the video information but does not indicate how the video information is obtained in sequence from the camera pick-up tube or how it is displayed in the same sequence on the monitor picture tube. Figure 3 shows the scanning process which enables the sequential pick up and display of the video information.

Scanning is essential to conventional TV systems. Without scanning, it would be necessary to have a separate pick-up device, video amplifier and display device for each element of the image. That is, a separate channel would be required for each element at the image. With scanning, only one channel is required since each element is examined once during every scan. Therefore, an image on the pick-up tube is examined element by element and is then displayed on the picture tube in the same manner.

Figure 3

It can be seen in Figure 3 that the camera pick-up tube and the monitor picture tube are scanned in the same manner. The scanning is a series of horizontal lines moving from the top to the bottom of the tube in both the camera and the monitor. This scanning process is caused by the deflection circuits which will be discussed in some detail later.

Figure 4 represents a checkerboard pattern projected through the lens on to the photosensitive surface of the pick-up tube and also shows the display on the monitor. Considering only one scanning line (AB) the image will be scanned from left to right - first scanning through the black area, then the white, then through black, then through white again.



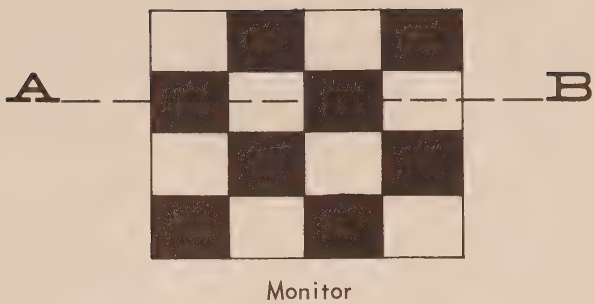


Figure 4

The video wave form representing the information presented in scanning line AB is shown in Figure 5.

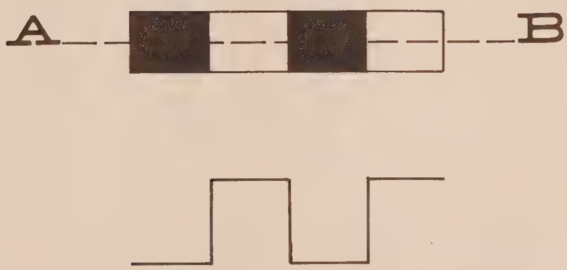


Figure 5

This video wave form shows the black information from the checkerboard represented as the most negative point and the white information as the most positive point. It can be seen that as the one line of the checkerboard is scanned, there is a change in level representing each change from black to white and white to black. This signal, incidentally, represents the polarity of the signal normally transmitted between the camera and the monitor. At other points in the system, however, the signal may be of opposite polarity; that is, the black area might be represented by a more positive level than the white area.

In order to provide the required scanning of the camera pick-up tube and the monitor picture tube, deflection circuits must be included in the camera and in the monitor. The addition of these deflection circuits is shown in Figure 6.

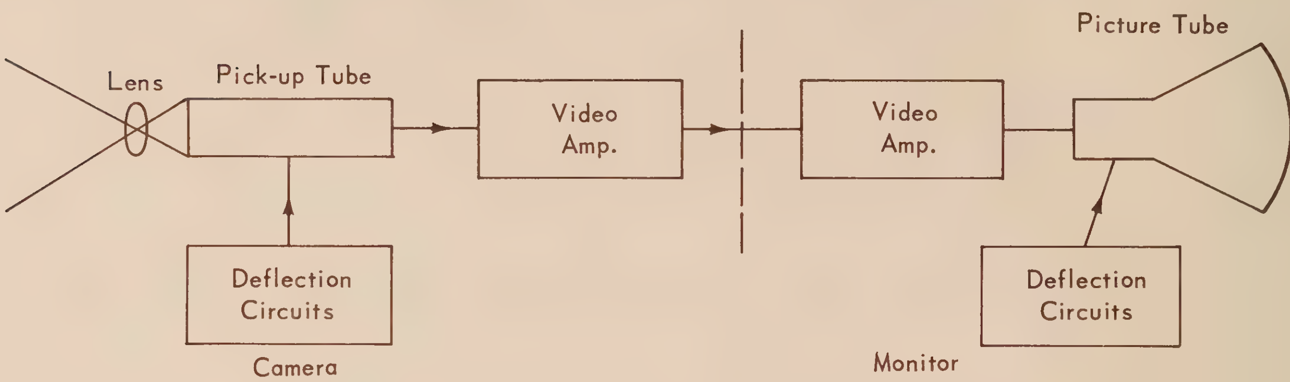


Figure 6

Since the scanning of the camera pick-up tube and the monitor picture tubes are done in both horizontal and vertical directions, two separate deflection circuits are required in both the camera and the monitor. These separate deflection circuits are shown in Figure 7.

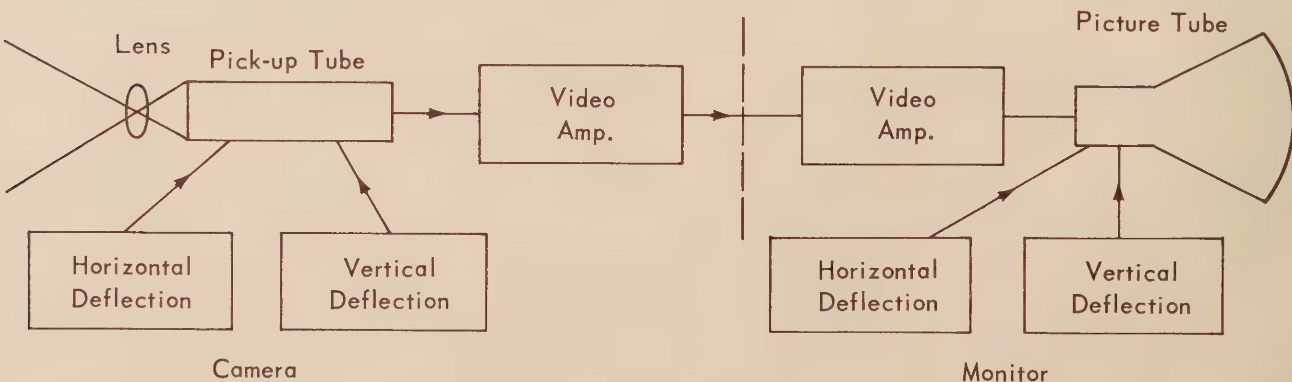


Figure 7

Of course, the sequence of scanning in the camera and in the monitor must be the same, and the scanning must be in step throughout the process. If the scanning of the camera and monitor were not in step, there would be no relationship between the parts of the image on the photosensitive surface of the pick-up tube and on the screen of the picture tube. When the geometric placement of components of the picture at the camera end and the monitor end of the system are ''in step'', the camera and monitor are said to be ''synchronized'' and the process of keeping the 2 ends of the system in step is called ''synchronization.''

The horizontal and vertical deflection systems of the monitor and camera should be wired together directly to provide synchronization, but this would require 3 cables connecting the camera to the monitor. That is, one cable for video, one cable for horizontal deflection and one cable for vertical deflection. To avoid the cost and complexity of multiple cables, circuitry such as that represented in the block diagram of Figure 8 is used.

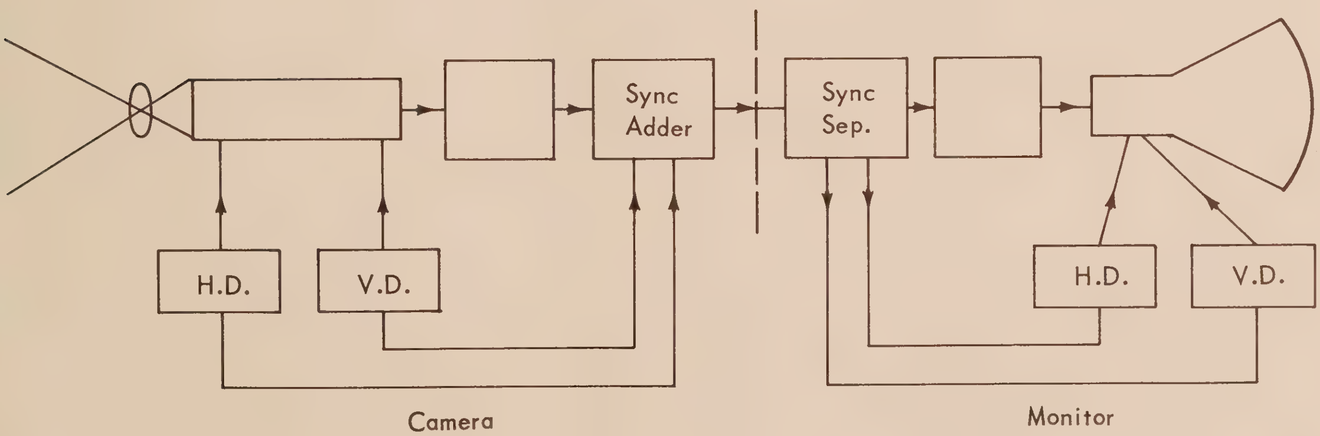


Figure 8

In Figure 8, the only addition to the circuit represented in Figure 7 is the sync adder in the camera and the sync separator in the monitor. The purpose of the sync adder is to combine the synchronizing signal from the horizontal and vertical deflection circuits in the camera with the video signal from the pick-up tube. The purpose of the sync separator in the monitor is to remove the synchronizing information from the video signal and to supply this information to the monitor horizontal and vertical deflection circuits. Figure 8 represents the entire TV system except that further breakdown of the blocks is required and that power supplies must be added in the camera and the monitor.

We will now proceed to examine the individual blocks of Figure 8, to further define the purpose of these blocks and to break them down into smaller blocks and then to individual circuits.

III. THE PICTURE TUBE

The picture tube of the monitor is the end point in the television system. It is the transducer of electrical energy into visible light, and it utilizes all of the electronic circuitry that proceeds it in the system.

The picture tube and the pick-up tube have many similarities in construction and application. These similarities involve the electron gun, the electron beam, and the method of deflection. Therefore, a large part of this discussion of the picture tube will apply to the pick-up tube.

The picture tube consists of an electron gun enclosed in a glass envelope with a fluorescent coating on the end of the envelope opposite the electron gun. The electron gun, in a sense, "shoots" a beam of electrons at the fluorescent coating on the front of the picture tube. The fluorescent coating will fluoresce (will emit visible light) in proportion to the density of the electron beam. The electron beam density can be changed by changing the potential on one of the electrodes in the electron gun.

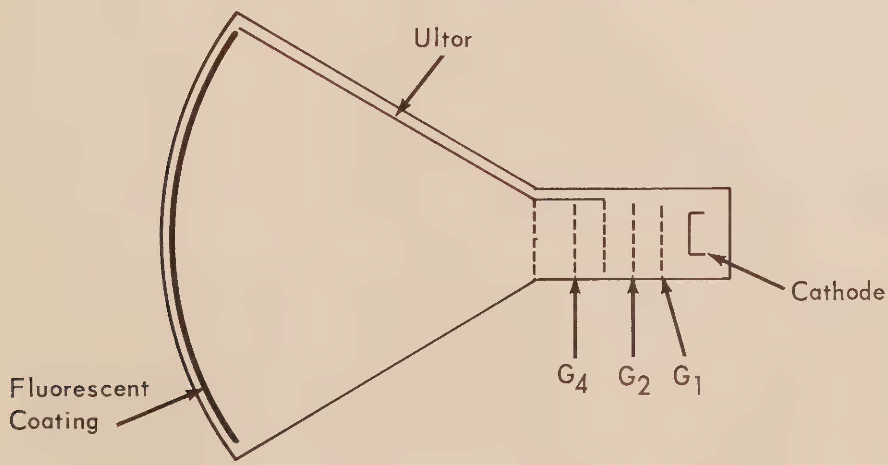


Figure 9

The simplified drawing of the picture tube shown in Figure 9 will be used to describe the operation of the electron gun. The electrons are emitted by the cathode and the density of the electron beam is controlled by the potentials on the various electrodes of the picture tube. As in the case of a typical electron tube, the greatest control of electron current is achieved by adjusting the potential difference between grid 1 and the cathode. Consequently, grid 1 is generally referred to as the signal grid although it matters little whether the signal is applied to the grid (with the cathode grounded) or to the cathode (with the grid grounded). In some equipment, which will be described later, the grid is at AC ground potential and the signal is applied to the cathode.

The electron beam must be accelerated toward the fluorescent screen of the picture tube in order to achieve sufficient electron velocity to provide illumination. To accelerate electrons, the ultor of the picture tube is operated at a very high potential.

The density of the electron beam is controlled by adjusting the potential on G_3 (as well as being controlled by G_1) and focusing of the electron beam is accomplished by adjusting the potential on G_4. Focusing of the beam is required in order to have the beam converged from the relatively large bundle of electrons at the gun to a fine point at the fluorescent screen.

Deflection of the electron beam, to cause it to scan the entire screen area, will be discussed in the following section.

IV. DEFLECTION

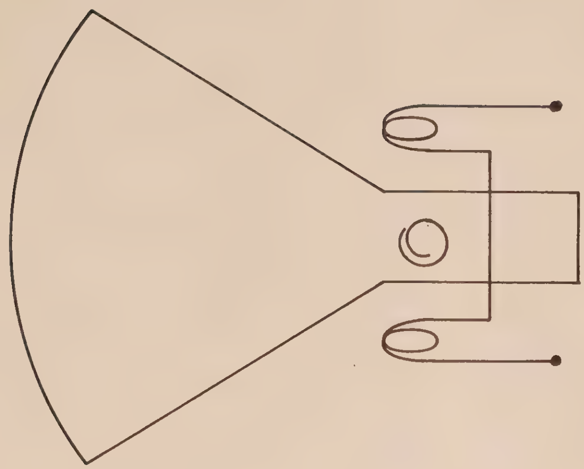


Figure 10

In Figure 10, deflection coils have been added to the picture tube. These coils are not located within the picture tube but, rather, are located just outside of the tube. The deflection coils are used to deflect the electron beam by magnetic action. The action of the magnetic field on the electron beam is such that the beam is deflected at right angles to the magnetic field. That is, the magnetic field caused by passing current through the coils that are positioned vertically, above and below the picture tube, will cause the electron beam to move horizontally within the tube.

In an ideal system the electron beam will be deflected linearly with a linear change in the current in the deflection coils. That is, if the horizontal deflection coils (the coils located above and below the electron beam) are provided with a current that is increasing linearly with time, the electron beam and therefore the spot of fluorescence on the face of picture tube, will move from left to right, or right to left, at a uniform rate.

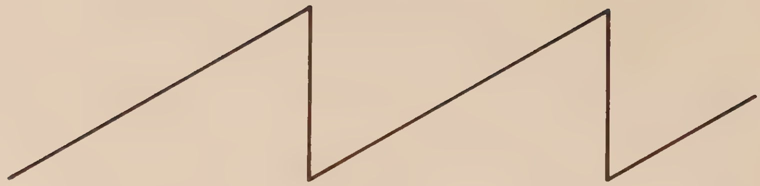


Figure 11

Figure 11 shows the current wave form in a deflection coil. Note that the current increases linearly with time to a maximum then rapidly decreases and once more begins to increase. This current, if applied to the horizontal deflection coils, would cause the fluorescent spot on the front of the picture tube to move at a constant rate from one side of the face of the tube to the other and then rapidly return to the starting point and repeat the process.

In a television system the electron beam is simultaneously deflected vertically and horizontally. Vertical deflection is much slower than horizontal deflection and, consequently, there are many scans horizontally for each scan vertically. However, since vertical and horizontal deflection are occuring simultaneously, the electron beam does not actually move horizontally but does have a slight diagonal movement. This is shown in Figure 12.

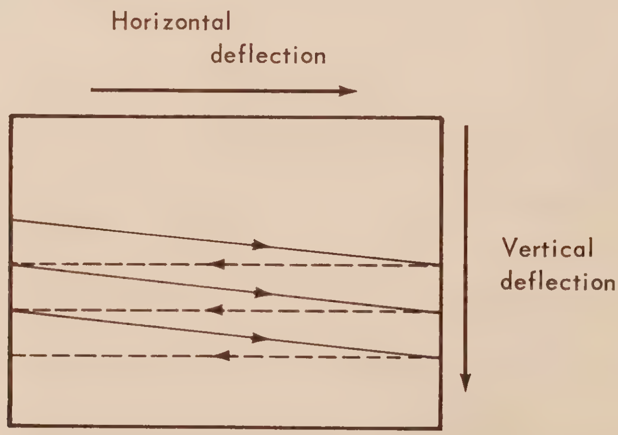


Figure 12

It can be seen in Figure 12 that the "trace" part of horizontal deflection has much more slope than the much faster "re-trace" portion (see wave form Figure 11). This is because

much less vertical deflection occurs during the short re-trace time. In the equipment to be discussed, the horizontal deflection rate is 15,750 per second (15,750 traces and 15,750 re-traces) and the vertical deflection rate is 60 per second. Therefore, there are 15,750 cycles of a sawtooth current in the horizontal deflection coils and 60 cycles of a comparable sawtooth current in the vertical deflection coils, in one second.

The means of generating sawtooth current wave forms will be discussed in the following section.

V. SAWTOOTH GENERATION

It is necessary, as indicated in the previous section, to generate a linear sawtooth of current in both the vertical and horizontal windings of the deflection coils. The two sets of coils must be treated differently, however, because of the frequencies or repetition rates of the sawtooths involved.

The vertical deflection coils can be considered to be essentially resistive. That is, the coil can be replaced with a resistor of a value equal to the resistance of the coil to determine the magnitude and wave form of the current. If a linear sawtooth voltage is applied across the vertical deflection coil, then, a linear sawtooth of current will flow in that coil. It must be kept in mind that this is true only for the relatively low frequencies where the inductance of the deflection coil can be neglected.

The horizontal deflection coil, in contrast to the vertical deflection coil, is essentially inductive. That is, the impedance of this coil at the horizontal deflection frequency is essentially inductive with very little resistance. Once more, the horizontal deflection coil is considered to be essentially an inductor only at those frequencies that are used for horizontal deflection.

Since the horizontal deflection coils can be treated as an inductor then it can be seen that it will not do to simply supply a sawtooth voltage wave to the deflection coils if we wish to achieve a sawtooth current in the coils. In order to achieve a sawtooth current wave in the coils it is necessary to supply a non-sawtooth voltage wave.

Since the vertical deflection coils can be treated as a resistor and since we wish to provide this resistor with a sawtooth voltage wave we will first examine the methods of generating such a sawtooth voltage wave. Figure 13 shows the simplified schematic of a sawtooth voltage wave generator.

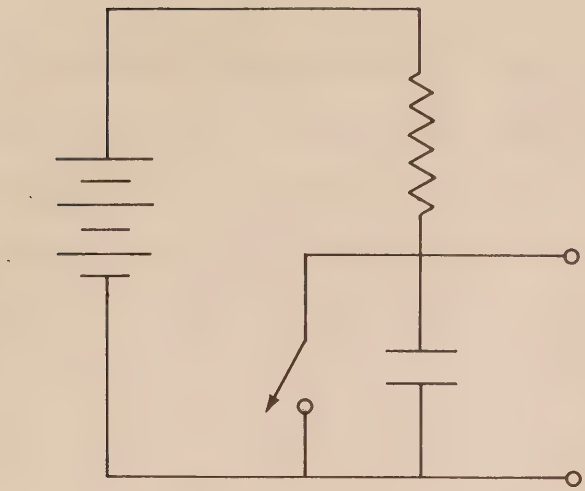


Figure 13

It can be seen that when the switch is closed the full battery voltage will appear across the resistor and no voltage will appear across the capacitor. However, when the switch is opened a voltage will appear across the capacitor. The magnitude of this voltage will depend on the length of time after the opening of the switch and this voltage will eventually reach the battery voltage. The rate at which the voltage will rise across the capacitor will depend on the value of the capacitor and the value of the resistor. The larger the capacitor and/or the larger the resistor the longer it will take the voltage to reach a given value. Since the product of the value of the resistor and the value of the capacitor determines the time it takes for the voltage to reach a given value, the product of the resistor and capacitor values is known as the "time constant". This time constant is abbreviated as TC and is equal to RxC with R in ohms and C in farads or R in megohms and C in microfarads.

The theoretical time required for the capacitor to charge to the battery voltage is infinite, but the capacitor will come within a small fraction of a per cent of the battery voltage within five time constants. The capacitor will reach about 63% of the battery voltage in one time constant. It can be seen, then, that the voltage across the capacitor does not rise in a linear manner. However, for the first small fraction of a time constant the voltage rise will be fairly linear.

Now if we open the switch for that first small fraction of a time constant and then close the switch the voltage will instantly decrease to zero. If we then repetitively open the switch for that small fraction of a time constant, then instantly close the switch, then reopen it, and continue to repeat this process we will generate, across the capacitor, a linear sawtooth voltage wave. In this idealized circuit the voltage falls instantly to zero when the switch is closed. In practice, however, any switch, especially when this switch is a tube or a transistor rather than a mechanical switch, has some resistance when closed. This closed or ''on'' resistance causes the fast fall of the sawtooth wave to occur in some small but not zero, period of time.

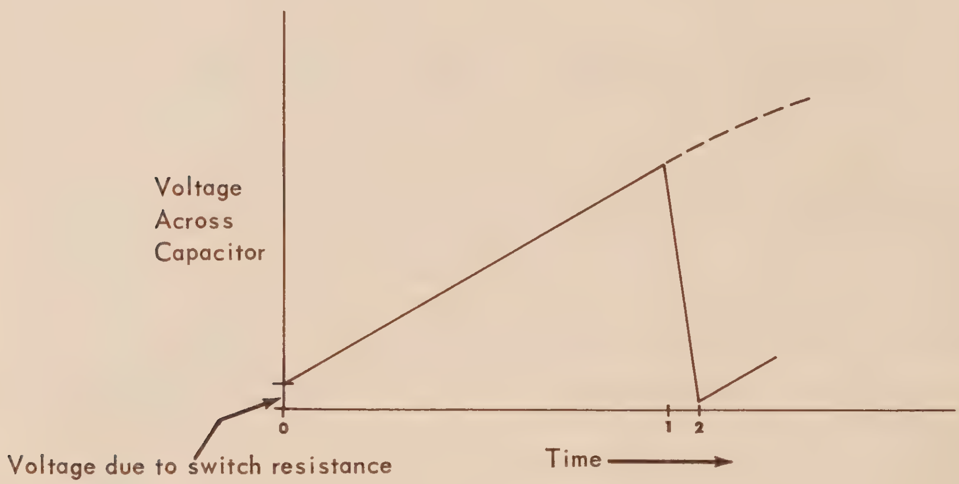


Figure 14

Figure 14 shows the wave achieved with the practical circuit. Notice that on the time scale, the horizontal axis, at time zero there is a small voltage across the capacitor even though the switch is closed. This voltage is due to the resistance of the switch. At time equals zero the switch is opened, and the voltage across the capacitor begins to rise in a nearly linear manner. At time equals one, the switch is closed and the voltage across the capacitor falls to its initial value which it reaches at time equals two. Note that the

capacitor did not discharge instantly but took some time to discharge, that time caused by the resistance of the switch. The switch in Figure 13, as will be shown in the following sections, will actually be a tube or a transistor. This tube or transistor is turned on with a pulse and is turned off at the end of that pulse.

Horizontal deflection, as stated before, is not accomplished by supplying a sawtooth voltage to the deflection coil(s). However, the horizontal deflection coil is not a pure inductor as described in the previous simplifying discussion. The horizontal deflection coil is primarily inductive but it has a shunt capacitance and some resistance. Therefore, a simple voltage pulse, which would cause a sawtooth current to flow in a pure inductor, is not satisfactory for horizontal deflection. Voltage wave forms driving the horizontal deflection coils will be found to be modified pulses with some sawtooth component. The exact shape of the driving voltage will depend on the inductance, capacitance and resistance of the horizontal deflection coil being driven.

VI. SWITCHES, MULTIVIBRATORS AND BLOCKING OSCILLATORS

In this section we will be concerned with the tube or transistor switch which was mentioned in the preceding section. We will also be concerned with the fundamentals of operation of multivibrators and blocking oscillators. These oscillators are, in television systems, used to provide the pulses which "trigger" the switches. In some cases the "trigger" is a part of the multivibrator or blocking oscillator.

Figure 15 shows a simple transistor switch or discharge device. This transistor could be replaced with a tube and this is done in some types of equipment. The transistor, in this case, operates as a switch which is closed when a pulse is applied to its base and is opened when the pulse is removed. Therefore, the transistor can replace the switch that is shown in the basic sawtooth forming circuit in the preceding section.

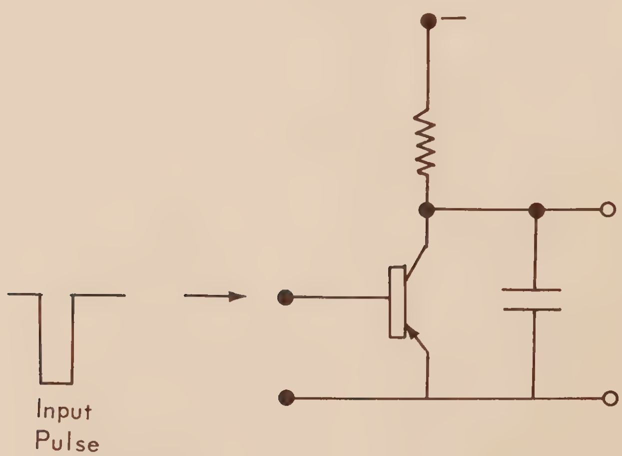


Figure 15

A multivibrator or blocking oscillator is often used as the source of the pulse which is used to "trigger" the transistor or tube switch. The circuitry can also be so arranged that the multivibrator or blocking oscillator circuit includes the switch. However, for the sake of clarity we will describe the multivibrator and blocking oscillators as separate circuits.

Multivibrators and blocking oscillators are used for purposes other than to supply the pulse which "triggers" the sawtooth forming circuits. They are used to generate pulses used for the synchronizing and blanking circuits and for other purposes in the closed circuit television equipment.

A basic multivibrator circuit is shown in Figure 16.

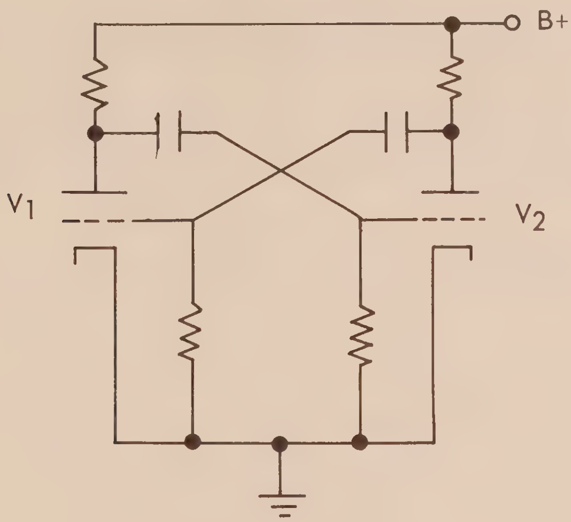


Figure 16

The circuit shown in Figure 16 is a tube circuit but a very similar configuration can be used if the tubes are replaced with transistors. Note that the plate of one tube is capacitively coupled to the grid of the second tube and that the plate of the second tube is capacitively coupled to the grid of the first tube. This arrangement provides positive feedback.

The action of the multivibrator is as follows: Assume that for some reason, due to unbalance in the circuit, V_1 starts conducting. This will cause a negative going pulse to be coupled to the grid of V_2. V_2, then, will become less conductive causing the plate voltage to rise. The rising plate voltage will cause a positive going pulse to be coupled to the grid of V_1 causing it to go further into conduction. This process will continue until V_1 is completely saturated. At this time, the signal coupled to the grid of V_2 will start rising in a positive direction as the coupling capacitor to this grid begins to

discharge through the grid resistance. The time required for V_2 to begin to conduct will be dependent on the time constant of the coupling capacitor and its grid resistor. It can be seen that this process is repetitive, and that the time each tube is in a conducting or non-conducting state will depend on the time constants involved. By properly adjusting these time constants the multivibrator can be made to free-run at any selected frequency and the "on" and "off" time of either tube can be adjusted to be any selected percentage of that total cycle. The multivibrator can also be synchronized to a frequency near its free-running frequency by injecting a signal into the circuit to cause one of the tubes to conduct prior to the time of the complete capacitor discharge.

Either section of the multivibrator can be used as a switch since it will have both an on state and an off state.

The blocking oscillator shown in Figure 17 is in many ways comparable to the multivibrator.

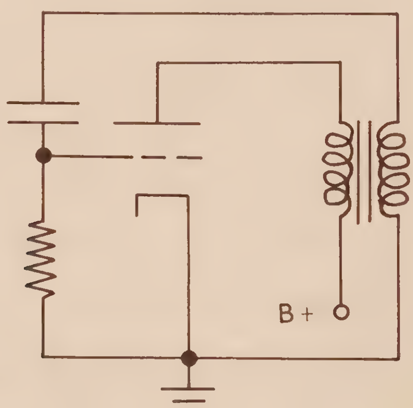


Figure 17

In the blocking oscillator, positive feedback is provided by a transformer rather than by a tube or transistor. Note that the blocking oscillator has a resistor-capacitor time constant which is effective in determining the repetition rate or frequency of oscillation.

In the blocking oscillator shown in Figure 17 the transformer is phased so that as the plate of the tube is swinging in a negative direction the signal coupled to the grid will cause the grid to go in a positive direction.

The foregoing is not to be considered anything approaching a comprehensive discussion of the action of multivibrators and blocking oscillators. The details of the operation of these circuits will be found in the appropriate sections of the equipment instruction manuals. However, at this stage it is only necessary that the reader recognize what these circuits are able to do. They are able to act as switches and are capable of delivering pulses of adjustable durations. By properly selecting the circuit constants the oscillators can be made to operate over a wide range of frequencies.

In section IX we will see how the pulses from these circuits are used in the camera, and in section X we will see how the oscillators can be synchronized.

VII. THE VIDICON

The vidicon pick-up tube is, as stated in a previous section, similar in some respects to the picture tube. The vidicon tube, although a rather simple device, does have some unique operating characteristics which will now be described.

Of all the components required in an industrial closed circuit television camera, probably the most important is the vidicon tube. The illustration of the vidicon tube, Figure 18, is highly exaggerated to illustrate operational functions. This sketch should be referred to during the vidicon discussion.

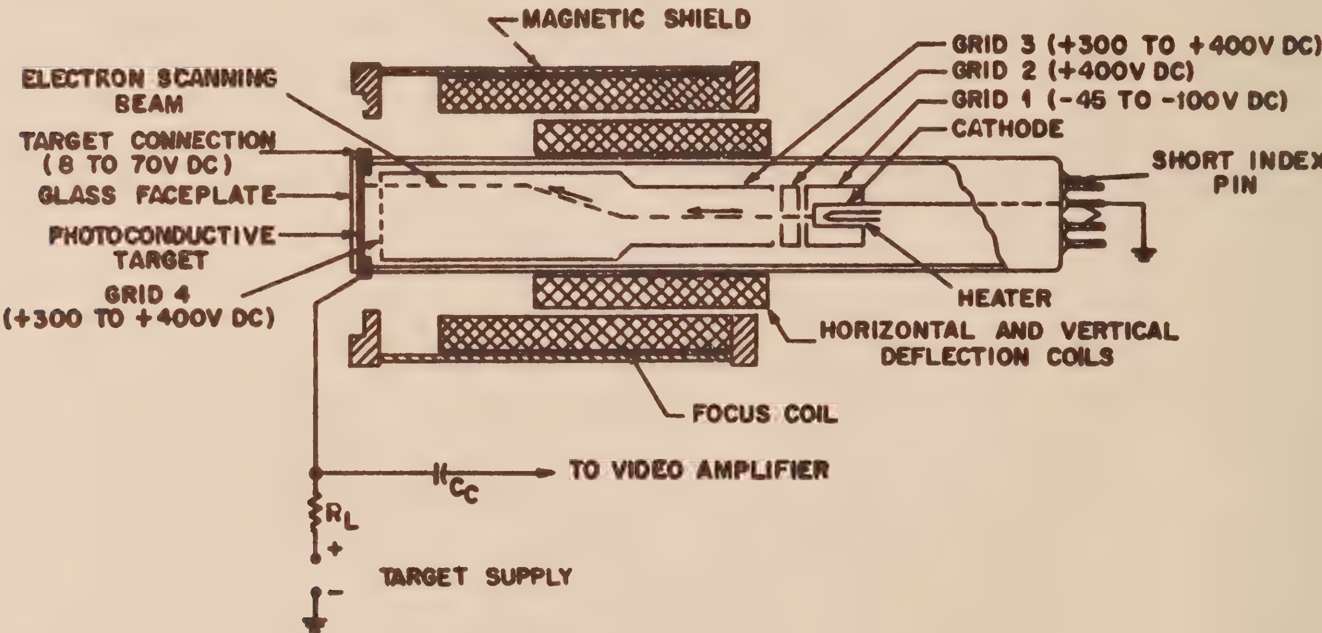


Figure 18

Operational Functions

The light-sensitive element may be visualized as consisting of two separate elements electrically: (a) a transparent conducting film coating on the inner surface of the glass face plate, and (b) a thin layer of photoconductive material on the scanning side.

Four grids are used, Grid No. 1 is the control grid and has a picture cutoff value of –45 to –100 volts. Grid No. 2 is an accelerator grid usually operated at a fixed positive voltage in the vicinity of 400 volts. Grids 3 and 4 are focusing electrodes. The focusing grid potential (between plus 300 and 400 volts) creates an electrostatic field which, in conjunction with the uniform magnetic field from the external focusing coil, causes the electron scanning beam to focus at the photoconductive target (signal-electrode). When the current through the external focusing coil is fixed (constant magnetic field) focusing grid voltage is varied (variable electrostatic field) to allow optimum electrical focus of the beam.

Grid No. 4 is actually a fine mesh screen adjacent to the photoconductive layer. This grid is connected to grid No. 3 and is, therefore, at the same positive potential. Its purpose is to provide a uniform field on the beam side of the target. This causes the scanning beam to impinge perpendicularly on the photoconductive layer regardless of the angle from which it approaches. The target is maintained at a much lower positive potential (8-70 volts) and the arrangement may be seen to provide a "decelerating" action of the scanning beam. Hence, grid No. 4 is often termed the decelerator grid.

The electron gun uses a 6.3 volt heater to heat a thermionic cathode, which may be placed at ground potential as shown in Figure 18.

The metal ring around the front end of the tube is the signal lead connection, and the load resistor is connected to the electrode in series with the B+ supply. The complete circuit may then be seen to constitute ground, the scanning beam, the light sensitive surface, the load resistor R_L, and through the power supply to ground.

Under no light conditions, the photoconductive layer is essentially an insulator exhibiting a very high resistance. One plate of the electrically separated plates is charged to the positive potential of the signal electrode, while the other plate is floating. For the purpose of understanding the basic theory, we may think of the two plates as forming a capacitor with a dielectric resistance that is variable under conditions to be described. In the present analysis (no illumination reaching the target), the beam of negative electrons being swept across the target area under the influence of the scanning currents through the deflection yoke will be deposited upon the positive target surface until it is charged down to cathode potential. Thereafter the remaining beam electrons are turned back under the influence of the positive grids to form a return beam. Although a considerable charge now exists across the opposite plates of the light sensitive element, the resistance is so high that very little current is passed. What little current does exist is termed the "dark current" of the tube.

Assume now that a light image is focused by the lens on the light sensitive element. The transparent conducting film on the inner surface of the glass face plate will now conduct slightly, an amount depending upon the intensity of the light at that particular point. The lowered resistance adjacent to this particular conducting element draws a few electrons from the plate on the gun side, causing it to rise slightly toward the

positive potential of the target supply. In this way, a positive potential pattern in accordance with the light distribution in the focused image is caused to exist on the gun side of the target. Thus, more electrons are extracted from the total beam current to satisfy this deficiency of electrons on the target. This increased current in the signal path which includes R_L causes a greater voltage drop through this resistor, which in turn causes the point where the coupling capacitor C_c is connected, to swing in the negative direction. Since no light conditions result in minimum current and highlights cause maximum current, the signal to the amplifier is observed to swing in the negative direction for highlights in the scene, and positive for black portions.

Signal Polarity

The polarity of a television signal is always given in terms of picture black, since blanking signal amplitude is always approximately near picture black and is held at a given reference level for any particular system. For this reason, the polarity of the signal at the output of the vidicon is said to be black positive, simply positive polarity.

Target and Beam Control Effects

Variation of target voltage, when manually adjusted, effects shading and contrast of the picture for a given amount of light on the scene. If low light level conditions are encountered, target voltage is raised to increase the sensitivity of the vidicon tube. Too high a target voltage will deteriorate picture quality, because of ''dark current'', as well as increase the tendency for image ''burn in.''

The beam control adjusts the potential on the vidicon grid No. 1. Decreasing this bias potential increases the vidicon beam current, which results in resolution of the highlight portion of the scene. Further bias reduction (increasing beam current) gradually resolves the brightest highlights. The observed action results from the fact that only a small

amount of beam current is needed to resolve the darker portions, (less positive points of the target) but will not resolve the brighter (more positive) areas. As the beam current is increased, the picture ''wipes clean'' with the highlights appearing resolved last. The Beam Control is left just barely past the point of good highlight resolution, since a further increase causes excessive beam current that deteriorates the resolution in the picture.

The vidicon description is expanded somewhat in Motorola's CCTV camera instruction manual. Since the vidicon is an expensive and damageable component of the CCTV system, the maintenance technician should be thoroughly familiar with the precautions concerning its use. It is suggested that the reader become familiar with all of the material in the instruction manual, especially that concerning the vidicons, before attempting to install or service the CCTV camera.

VIII. CAMERA VIDEO AMPLIFIER

The camera video amplifier in this discussion will be considered only as the amplifier of the signal from the vidicon to the transmission line. The addition of synchronizing and blanking information to the video signal will be covered in the following section.

The camera video amplifier must do a great deal on its job of amplifying the small signal from the vidicon. The output signal from the vidicon amounts to a few millivolts into a rather high impedance of several thousand ohms and this signal must be amplified to a level of 1 to 2 volts into a relatively low impedance of 75 ohms (the usual transmission line impedance). The power gain of this amplifier is obviously very large.

The camera video amplifier must contribute a minimum of noise, must have a bandwidth to approximately 10 megacycles. The amplifier must also have a response that rises at the high frequencies to compensate for the reduced output of the vidicon at these higher frequencies.

In order to preserve the dc component of the video signal, to achieve a uniform background in a reproduced picture, the video amplifier must either be direct coupled or a dc restoration circuit must be provided. Since direct coupling is impractical the dc level is restored with a keyed clamp circuit.

The input stages of the camera video amplifier are the most important stages in determining the noise contribution. Consequently, very careful design and component selection is required in this area.

A transistor which would contribute essentially no noise to the video signal if installed in a later stage of the video amplifier might very well add enough noise if used in the input stages to obscure the video signal. The first stage of the video amplifier must provide a rather high impedance, in the order of 10k ohms to 100k ohms, in order to not significantly attenuate the relatively feeble signal from the vidicon.

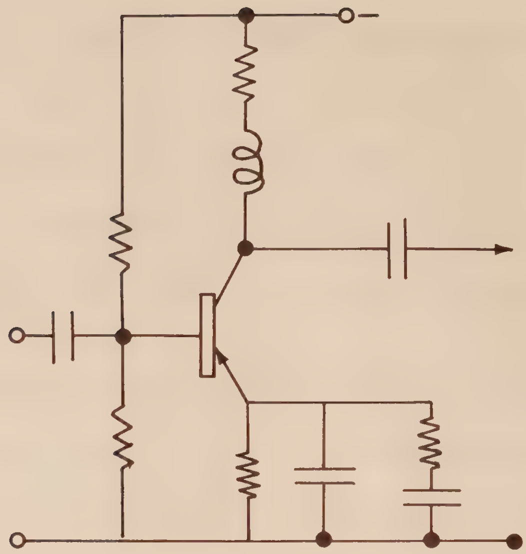


Figure 19

Most of the voltage amplification of the video amplifier is provided by the intermediate stages. Figure 19 shows a simplified schematic of one of these stages. This stage has the general form of a conventional RC coupled audio amplifier stage. However, note that an inductance is included in the collector circuit and note the means of bypassing the emitter resistor.

The purpose of the small inductance in the collector circuits is to cause the load impedance to rise at the higher frequencies to compensate for the decreased gain of the transistor at these frequencies. This inductor also tends to compensate for the stray capacitance shunting effects which tends to cause the amplifier gain to decrease at higher frequencies.

The emitter bypass arrangement also causes the gain of the stage to rise at higher frequencies. The small capacitor bypassing the emitter resistor has no effect at low frequencies but decreases the degeneration at higher frequencies. The second bypass arm, the resistor and capacitor in series, has a similar effect but at some frequencies the capacitor becomes a small impedance compared to the resistance. At frequencies above the frequency at which the capacitor has essentially zero impedance the response of the amplifier no longer increases.

The combination of the various inductors and capacitors is used to shape the response of the video amplifier to provide the necessary compensation for the vidicon, the transistor gain fall-off and stray capacitances.

The output stage of the video amplifier must drive a 75 ohm transmission line. It must have an output of one to two volts and it must be linear in operation. The output stage of the video amplifier, to provide these characteristics, is usually a common collector (emitter follower) circuit.

In the next section we will show how the sync and blanking signals are added to the video information prior to output stage of the amplifier. The output stage, after the addition of sync and blanking signals, will then deliver the "composite" video signal.

IX. SYNC AND BLANKING ADDITION

Synchronizing (sync) and blanking could be, and in some equipment are, included in the same pulses. Separate sync and blanking provides improved synchronization and allows more control of a CCTV system.

The pulses used for sync and blanking are often derived from the same multivibrators or blocking oscillators which are used to supply the pulses for deflection in the camera. In some cases, separate synchronized multivibrators or blocking oscillators are used. The pulses, however they may be derived, are often modified in the camera circuitry. Figure 20 shows some of the possible, but not necessarily typical ways of modifying pulses.

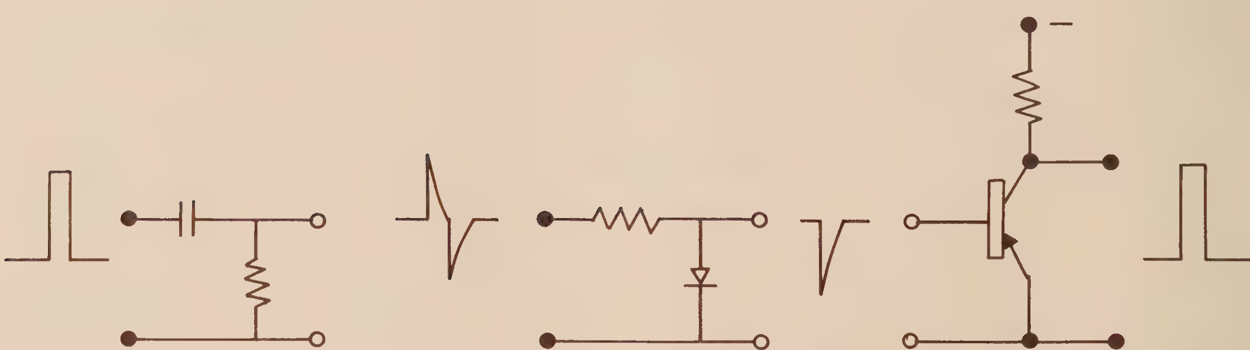


Figure 20

On the left of Figure 20 is a differentiator circuit. The pulse to the left of the differentiator indicates the input pulse and the wave form to the right indicates the output of the differentiator. This output wave form if inserted into the clipper circuit would appear on the output of the clipper as indicated.

If this pulse, which has had one polarity removed by the clipper, were inserted into the pulse shaper, the resultant wave form would be that shown on the far right, Figure 20. Note that the output of the pulse shaper is now rectangular since the pulse shaper has saturated on the input pulse. The pulse shaper then is simply a saturating amplifier stage which clips and amplifies the input signal.

Since the vidicon is blanked during retrace, the video signal will have the wave form indicated in Figure 21(a).

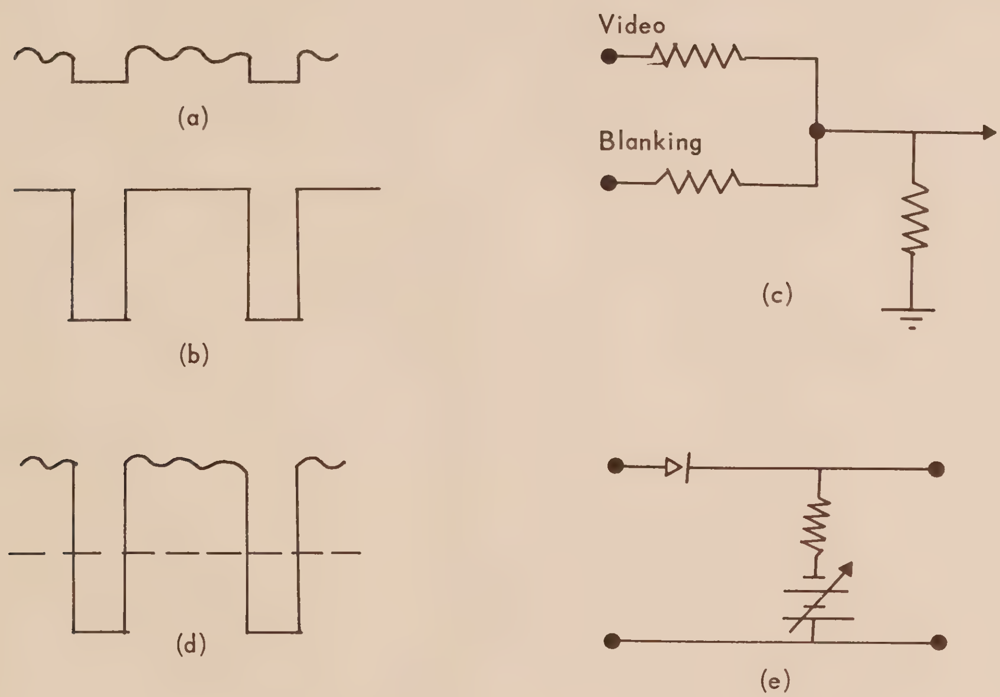


Figure 21

The wave form in Figure 21(a) represents video information at the horizontal rate. That is, the period of time between the negative going pulses is the time of one horizontal line. If this signal were to be added to the signal in Figure 21(b) by the resistive adder shown in Figure 21(c) the resultant signal would be that shown in Figure 21(d). Figure 21(d) represents the sum of the video signal and the inserted blanking signal. The biased diode

clipper shown in Figure 21(e) is used to clip off the unwanted portion of this combined signal. The adjustable bias voltage on the diode would be set to determine the level at which the combined signal is clipped. The control of this voltage is called the "set-up" control.

Now we have a video signal with blanking added and with adjustable set-up. The next step is to add the synchronizing signal which will be done in a circuit comparable to Figure 21(c). The difference is that we will insert the combined video-blanking signal into one arm and the synchronizing signal into the other arm. By adjusting one or both of the resistors we can adjust the amount of synchronizing signal added. Figure 22 shows the wave form of the combined video-blanking-sync signal. This signal is called the composite video signal.

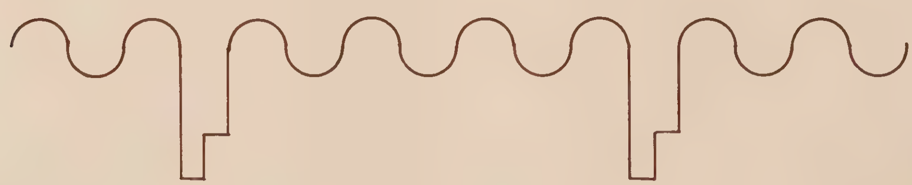


Figure 22

In practice both horizontal and vertical blanking sync signals are added to the video information. The usual practice is to combine horizontal and vertical blanking pulses for insertion into the video amplifier and to combine vertical and horizontal sync pulses for insertion into the amplifier.

The techniques for combining these signals are the same regardless of whether or not we add only horizontal information or the combination of horizontal and vertical.

The above description of sync and blanking insertion describes only one approach. With an understanding of this approach, however, the maintenance technician should be able to recognize similar circuitry as it appears in television cameras.

X. SYNC SEPARATION

The composite video signal once delivered to the camera is used both as video information and as synchronizing information. The video information is amplified in the monitor video amplifier, which will be discussed in the following section, and the synchronizing information is separated and used to synchronize the horizontal and vertical oscillators.

The sync information in the Motorola monitor is taken from the video input jack and amplified. The synchronizing signal amplifier, although it will be amplifying video information as well as sync, need not have bandwidth as great as the video amplifier. The reduced bandwidth requirement is due to the fact that the sychronizing portion of the signal is composed of relatively low frequency components.

This reduced bandwidth composite signal out of the sync amplifier is then clipped to remove the video information. The resultant signal is the synchronizing information. The removal of the video information is accomplished by a clipper similar to one described in an earlier section. However, the clipper used in the monitor is self-biasing. That is, the clipping point is established by the signal. Figure 23 shows a simplified clipper circuit.

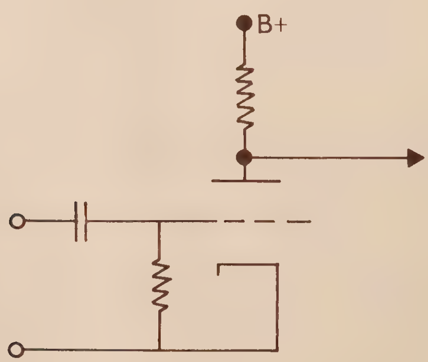


Figure 23

Note that the tube in Figure 23 has zero self bias. The amount of biasing on the tube will be established by the level of the input signal. The result is that only the most positive going portion of the signal will appear across the output load resistor. Therefore,

if at this point in the system the sync is positive going, only the sync information will appear across the output load resistor.

The next step in sync separation is to channel the horizontal synchronizing information in one direction and the vertical synchronizing information in another direction. This can be done by use of the integrating and differentiator circuits in Figure 24.

Figure 24

Figure 24(a) shows a simple single section integrator. This circuit is essentially a low pass filter and its output will consist only of the lower frequency components of the input signal. Since the vertical sync signal has a longer duration, and consequently is a lower frequency signal than the horizontal information, the output of the integrator will consist of essentially only vertical sync.

Figure 24(b) shows a simple single section differentiator. The differentiator is a high pass filter, and consequently its output will contain primarily the shorter duration, higher frequency, horizontal sync information.

Improved integration and differentiation, to provide better low pass and high pass action, will be achieved with multiple section filters. Therefore, in some equipment the integrators and differentiators will be cascaded.

In practice, in most television monitors, horizontal synchronization is accomplished in a more complicated manner. A horizontal AFC system is normally used. The purpose of the horizontal AFC system is to provide a "fly wheel" action so that the horizontal oscillator will not be triggered by random noise pulses. The action of the horizontal AFC system is covered in the monitor instruction manual.

XI. THE MONITOR VIDEO AMPLIFIER

The monitor video amplifier is required to have bandwidth comparable to the bandwidth of the camera video amplifier. The monitor video bandwidth, however, is essentially flat and does not have the rising characteristics of the camera video amplifier. The monitor video amplifier must have a gain control to control the contrast of the reproduced image, it must have dc restoration and it must have sufficient output to drive the picture tube.

The gain of the video amplifier can be controlled in several ways. In the present Motorola equipment the monitor gain is controlled by adjusting the bias on a remote cut-off tube in the first stage of the video amplifier. Other means of controlling contrast include cathode degeneration of one of the video stages or simply a resistive voltage divider in the input.

DC restoration in the Motorola monitors is accomplished in the grid circuit of the output amplifier. The video output stage is then direct coupled to the picture tube so that the restored dc level is faithfully reproduced. In some equipment, dc restoration is accomplished after the video output stage and just prior to inserting the signal into the picture tube.

The video output amplifier is the most critical stage in the monitor amplifier. It must be capable of driving the picture tube in a fairly linear manner with a swing of about 100 volts peak-to-peak. It will be seen, by referring to the monitor instruction manual, that the video output amplifier uses two small inductors rather than one. These inductors, known as peaking coils, are used in a shunt-series arrangement. The reason for this shunt-series arrangement is to allow the use of the highest possible value of plate load resistor. Without the shunt-series arrangement a lower value of plate load resistor would be required and consequently the gain and output swing of the stage would be reduced.

The video signal to the picture tube, then, must be dc restored, must have a bandwidth in excess of 10 megacycles and must be linearly amplified to a level of approximately 100 volts peak-to-peak. For details of the monitor video amplifier circuitry refer to the monitor instruction manual.

XII. INTERLACE SCANNING

The scanning process, in examining and displaying the scene point by point, has been described in previous sections. We will now describe the details of this process.

Some television systems use non-interlaced scanning. In these systems the scanning of the vidicon and the picture tube is repetitive. That is, the horizontal scan lines for any cycle of vertical deflection fall on top of the scan lines of the preceding cycle.

In order to increase the vertical resolution of the television system without decreasing horizontal resolution, increasing flicker or requiring additional bandwidth, interlaced scanning is used. With perfect interlace, the vertical resolution of the television system is doubled as compared to a non-interlacing system.

Interlace scanning is the process of causing the horizontal scanning lines of one vertical scan to fall between the lines of the preceding and following vertical scans (for a 2-to-1 interlace ratio).

Interlacing is accomplished by properly timing the initiation of horizontal and vertical deflection. For 2-to-1 interlace a one-half line relationship must exist between the horizontal and vertical deflection rates. For example: if there were 4½ lines horizontally for each vertical scan then the alternate 4½ line scans would be exactly interlaced.

Figure 25 shows non-interlaced and interlaced scanning. Note that Figure 25 indicates the process but not the actual number of lines used in a system.

Some Motorola equipment uses "random" interlace scanning. In the random system the horizontal and vertical deflection systems are not timed to provide a one-half line relationship (2-to-1 interlace) or a full line relationship (non-interlace). The random interlace equipment is designed to provide a random relationship between horizontal and vertical deflection so that at any time the relationship might be 2-to1, 3-to1, etc. The average performance of this equipment will be such that the vertical resolution will be approximately 85% of that of a perfect 2-to-1 system.

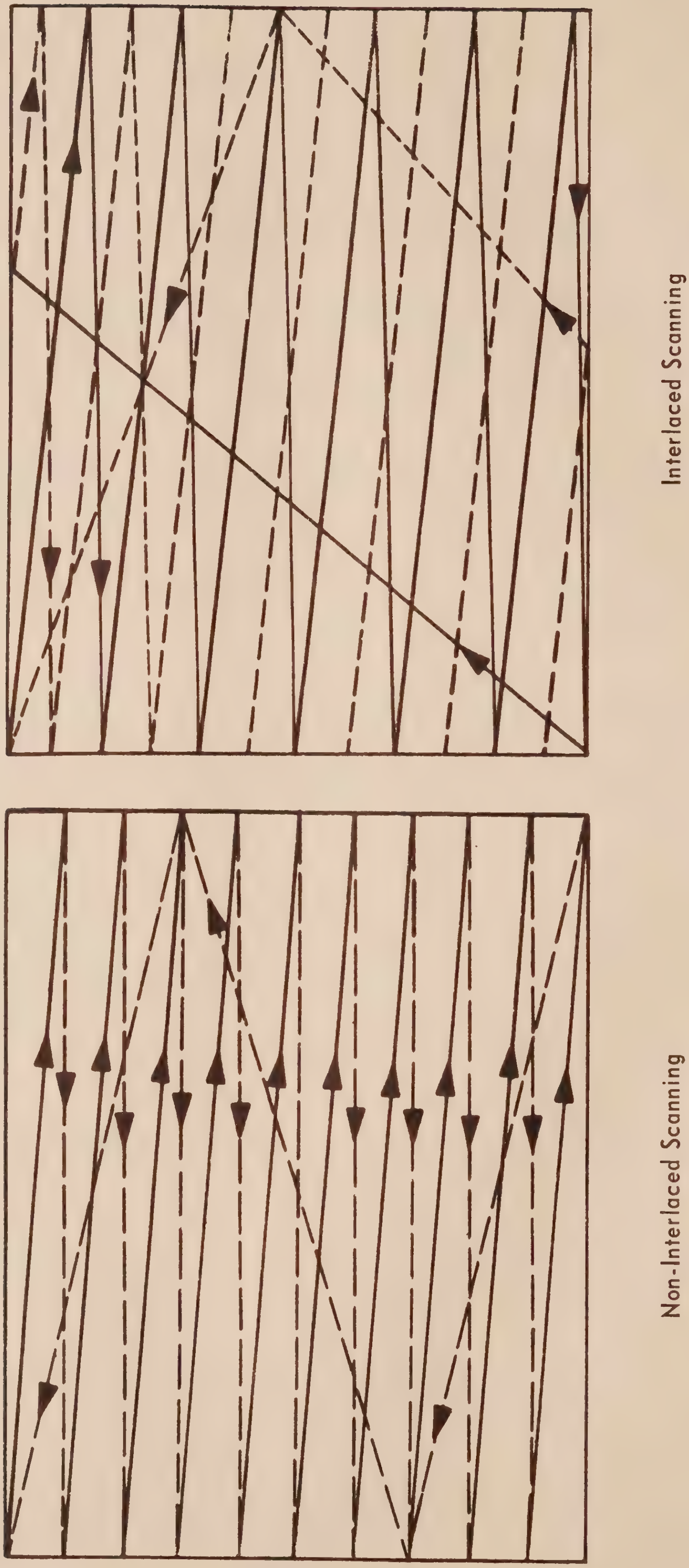


Figure 25

XIII. CLOSED CIRCUIT TELEVISION STANDARDS

No standards have been established for CCTV systems. However, a number of characteristics of these systems have become common.

The standards that will be discussed apply primarily to Motorola equipment, but in general these standards apply to a large part of the CCTV equipment now being manufactured.

A few terms must be defined before proceeding with this discussion:

Field – a field comprises the total number of scan lines during one scan of vertical deflection.

Frame – a frame consists of 2 field in an interlacing (2-to-1) system. The frame designation generally applies to two fields regardless of whether the system is a random or 2-to-1 system.

Aspect Ratio – the aspect ratio is the ratio of the width of the reproduced image to its height and is independent of the size of the reproduced image.

The following standards are exact only for a system meeting all of the EIA specifications but they are approximately correct for all Motorola equipment:

Aspect Ratio – 4-to-3

Field Rate – 60 per second

Frame Rate – 30 per second

Lines Per Field – 262½

Lines Per Frame – 525

Lines Per Second – 15,750

Time Per Scan Line – Approximately 63 microseconds

The horizontal resolution capability of the system not to be confused with the vertical resolution, is determined by the bandwidth and the horizontal scan rate. For equipment operating in accordance with the standards shown above the bandwidth of the system will restrict the resolution to 80 lines per megacycle. Therefore, a bandwidth of 10 megacycles will provide horizontal resolution of about 800 lines providing the resolution is not limited by the vidicon or picture tube.

Vertical resolution is not equal to the number of scan lines (525) because of the number of lines lost during vertical blanking and the probability of some picture elements falling between the scan lines. The vertical resolution in a 525 line system in perfect interlace is approximately 350 lines.

XIV. COAXIAL CABLES

One of the most important elements within a closed circuit television system is the interconnecting cable between the camera and the monitors. In almost all cases this cable will be the coaxial type.

This cable is constructed of a center conductor surrounded by a di-electric material and an outer conducting sheet covered with a suitable insulating material for mechanical protection. The spacing between the inner and outer conductor and the di-electric constant of the separating material determines what is known as the characteristic impedance of the cable. The characteristic impedance is the impedance we would see if we looked into an infinitely long length of cable. It is not the DC resistance, but rather the AC impedance that the cable presents when it is properly terminated. Most of the cables used in CCTV have a characteristic impedance of about 75 ohms. The 75 ohm cable has a ratio of inner to outer conductor that gives minimum attenuation and maximum power transfer.

A single shielded cable should provide adequate shielding in most installations, but if there is a high level of electrical noise or if power lines and transformers are in close proximity, double shielded cable should be used.

Recommended cable for use in conduit or messenger service is SKN6112A polyfoam di-electric cable. For short runs and drop lines, SKN6111A cable is suitable and less expensive. These cables may be used for all purposes except direct burial. The RG12/U is an RG11 type coaxial cable with an armor covering and is recommended for direct burial applications.

Our choice of cable is limited by the fact that a 75 ohm cable is the one that provides the most efficient use of materials. If this cable is to be used properly it must be terminated in a 75 ohm resistance. When more than one monitor is in a system, the termination must take place at the last monitor on the coax line. All monitors preceding the final

termination must have the video termination switch set to the high impedance position. Double termination may result in ghost images on the monitor presentation. No termination will result in weak video or loss of video and sync.

Coaxial cables are selected for a system based in characteristic impedance, physical properties and attenuation characteristics. The attenuation characteristics vary with the dielectric material within the cable and with the diameter of the cable (for a given characteristic impedance). The larger the outside diameter of the cable, for a given dielectric material, the lower attenuation.

Although the larger and more expensive cables have less attenuation, all coaxial cables have some attenuation and the attenuation increases with frequency. It is this characteristic, increasing attenuation with frequency, that dictates the uses of larger cables for long runs.

We can easily amplify a signal that has been attenuated but it is more difficult to equalize (flatten) the response caused by the frequency-attenuation effects. Therefore, in general the following rules apply with standard (non-equalized) Motorola equipment:

Use SKN6111A cable up to 1,000 feet.

Use SKN6112A polyfoam cable up to 2,500 feet.

Use special purpose cable and/or equalizer
amplifiers for runs greater than 2,500 feet.

XV. LENSES & LIGHTING

Knowledge of lighting and wise choice of lenses are mandatory for proper operation of a closed circuit television system. The ease with which lighting and proper lenses can be selected is shown in the following pamphlet "A Guide to Lenses and Lighting for CCTV Systems." This pamphlet can be used to avoid a good deal of trial and error in working with closed circuit television systems.

While normally the service technician will not be involved in the original selection of lenses, he may be requested to recommend alternate lenses as the system requirements may change or expand. Periodic cleaning of lenses is usually the only service required to maintain the optical system.

The choice of the lens or lenses for closed circuit television systems is dependent on many factors. Since there is a definite relationship between the focal length of the lens and the size of the reproduced image on the vidicon, the focal length of the lens can be selected to control the area of the scene that is viewed. The longer focal length lenses cover a smaller area at a given distance than the short focal length lens. Although the camera-to-subject distance is often fixed and, therefore, the focal length of the lens is fixed, there are many situations where the camera-to-subject distance can be selected.

A lens with a small f/number is a "fast" lens and with a large f/number a "slow" lens. Since it is more difficult and, therefore, more expensive to make a large diameter lens and since the f/number of a lens for a given diameter increases with focal length, in general the longer focal length lenses have higher f/numbers and are slower than the shorter focal length lenses.

The sensitivity of the Motorola Industrial Television cameras is very good. With these cameras we are able to work down to incident light levels, on typical scenes, in the order of a few foot candles. However, we can usually improve on scene reproduction by adding

appropriate lighting. In general, the lighting of a TV scene for pick-up by a vidicon camera should be flat, that is we should avoid high contrasts, since there is a limited range of contrast that can be reproduced properly by the system. The choice of supplementary illumination for indoor scenes is generally a choice between fluorescent or tungsten (incandescent floodlight bulb) illumination. The choice of tungsten or fluorescent illumination depends primarily on the colors of the scene. If the scene is rich in reds we can use less light for the same effective illumination by using tungsten illumination, if the scene is rich in blues we can use less light for the same effective illumination by using fluorescents. The light level requirements for a scene depend on many other factors including the lens and the type of camera being used. As a general rule the higher the illumination on the scene the better. An exception to this rule is in the case of the scene containing objects that are self-illuminated. Although Motorola cameras are capable of operating with a few foot candles of incident illumination, generally, the quality of the picture can be improved considerably by having a scene illumination of at least 100-200 foot candles.

To summarize the lighting considerations: We may use available light for daylight scenes outside. We may use available light inside down to a level of a few foot candles or we may have a reasonable level of interior illumination. In any case, the picture quality can be generally improved considerably by properly arranging lights, reflectors, or other means of getting the proper scene illumination. Poor lighting is often the cause of poor performance of a CCTV system. The maintenance technician should, in any case of low contrast or high noise, first check the performance of the lighting system.

XVI. MECHANICAL DETAILS

The following is presented to familiarize the reader with the type of equipment that may be found in a CCTV system.

Motorola transistorized cameras are available in several models. The electrical characteristics of the three of these models are identical. The indoor models are packaged so that access to the circuit boards and components is easily obtained by the quick removal of the side panels.

The all-weather camera is contained in a weatherproof housing that completely encloses the camera, lens and control junction box. Video and control cables enter the housing through two weatherproof glands at the rear of the unit. This camera is for outdoor applications and will operate through a temperature range of -30°C to +60°C. Removal of the top cover provides access to camera for servicing.

The explosion-proof model is housed in a cylindrical aluminum casting and is designed to be used where an explosive atmosphere may exist. As with the all-weather unit, the housing contains the camera, lens, and junction unit, and cables enter through glands in the rear panel. The camera must be removed from this housing for servicing.

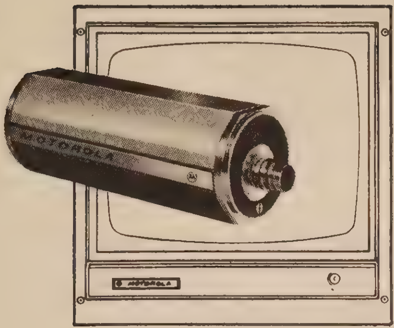
Control units available for these cameras include a local control box, normally used on the indoor camera, and remote controls for long distance control of the unit. The remote controls may be mounted as a panel on the Motorola 14" monitor or as part of the Motorola camera control unit, (CCU).

Pan and tilt units are available to remotely rotate or tilt the camera. Indoor, all-weather and explosion proof units are available. These units are powered by D.C. supplies which are included in the Motorola control systems.

Beside the variety of fixed lenses that can be used with the cameras, a zoom lens is optional equipment. This lens is operated by a low voltage DC power supply and permits the remote controlling of zoom (focal length), iris and focus.

The Motorola Camera Control Unit provides front panel space for the switches necessary to control the camera, pan and tilt unit and zoom lens, in addition to the power supplies needed for pan and tilt and zoom lens operation.

Tripods, video line amplifiers, video distribution amplifiers, universal camera mounts, weatherproof junction boxes, audio amplifiers, audio-video mixers, RF modulators, and a variety of coax and control cables are some of the accessories available to optimize a CCTV system for almost any given set of conditions.



MOTOROLA
CLOSED CIRCUIT TELEVISION EQUIPMENT

EIA CCTV DEFINITIONS

INTRODUCTION

These definitions were formulated by EIA Engineering Committee TR-17 on Closed Circuit Television, and were approved by that Committee for publication.

It is felt that the dissemination of these definitions will provide a valuable service to the industry in making available easily understood definitions of Closed Circuit Television equipment characteristics and performance.

Any comments or suggestions regarding these definitions are welcome, and should be directed to the Electronic Industries Association, Engineering Dept., 11 West 42nd Street, New York 36, New York.

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CLOSED CIRCUIT TELEVISION DEFINITIONS

AMBIENT TEMPERATURE (48 IRE 2, 11, 15.S1)

The temperature of the surrounding medium, such as gas or liquid, which comes into contact with the apparatus.

ASPECT RATIO (52 IRE 17.S1)

In television, the ratio of the frame width to the frame height.

AUTOMATIC BRIGHTNESS CONTROL (DISPLAY DEVICES)

The self-acting mechanism which controls brightness of the display device as a function of ambient light.

AUTOMATIC FREQUENCY CONTROL (48 IRE 2, 11, 15.S1)

An arrangement whereby the frequency of an oscillator is automatically maintained within specified limits.

AUTOMATIC GAIN CONTROL (58 IRE 3.S1)

A process by which Gain is automatically adjusted as a function of input or other specified parameter.

AUTOMATIC LIGHT CONTROL

Automatic Light Control is the process by which the illumination incident upon the face of the pickup device is automatically adjusted as a function of scene brightness.

AUTOMATIC PEDESTAL CONTROL

A process by which pedestal height is automatically adjusted as a function of input or other specified parameter.

AUTOMATIC SENSITIVITY CONTROL

The self-acting mechanism which varies system sensitivity as a function of the specified control parameters. This may include Automatic Target Control, Automatic Light Control, etc., or any combination thereof.

AUTOMATIC TARGET CONTROL

Automatic Target Control is the self-acting mechanism which controls the Vidicon target potential as a function of the scene brightness.

BACK PORCH (55 IRE 23.S1)

That portion of a Composite Picture Signal which lies between the trailing edge of a horizontal sync pulse and the trailing edge of the corresponding blanking pulse.

Note: The Color Burst, if present, is not considered part of the Back Porch.

BANDWIDTH (of a Device) (52 IRE 17.S1)

The range frequencies within which performance, with respect to some characteristic, falls within specific limits.

BLACK COMPRESSION (Black Saturation) (55 IRE 23.S1)

The reduction in gain applied to a Picture Signal at those Levels corresponding to dark areas in a picture with respect to the gain at the Level corresponding to the midrange light value in the picture.

Note 1: The gain referred to in the definition is for a signal amplitude small in comparison with the total peak-to-peak Picture Signal involved. A quantitative evaluation of this effect can be obtained by a measurement of Differential Gain.

Note 2: The over-all effect of Black Compression is to reduce contrast in the low lights of the picture as seen on a monitor.

BLACK LEVEL (55 IRE 23.S1)

That Level of the Picture Signal corresponding to the maximum limit of Black Peaks.

BLACK PEAK (55 IRE 23.S1)

A peak excursion of the Picture Signal in the black direction.

BLANKED PICTURE SIGNAL (55 IRE 23.S1)

The signal resulting from blanking a Picture Signal.

Note: Adding Sync Signal to the Blanked Picture Signal forms the Composite Picture Signal.

BLANKING - See "Blanking Signal"

BLANKING LEVEL (55 IRE 23.S1)

That Level of a Composite Picture Signal which separates the range containing picture information from the range containing synchronizing information.

Note: The setup region is regarded as picture information.

BLANKING SIGNAL (55 IRE 23.S1)

A wave constituted of recurrent pulses, related in time to the scanning process, used to effect blanking.

Note: In television, this signal is composed of pulses at line and field frequencies, which usually originate in a central sync generator and are combined with the Picture Signal at the pickup equipment in order to form the Blanked Picture Signal. The addition of Sync Signal completes the Composite Picture Signal. The blanking portion of the Composite Picture Signal is intended primarily to make the return trace on a Picture tube invisible. The same blanking pulses or others of somewhat shorter duration are usually used to blank the pickup device also.

BLEEDING WHITE (Beam Starved)

An overloading condition in which white areas appear to flow irregularly into black areas.

BLOOMING (54 IRE 12.S1)

An increase in the (spot) size caused by an increase in signal intensity.

BOUNCE

Sudden variations in picture presentation (brightness, size, etc.) independent of scene illumination.

BREATHING

VARIATIONS similar to "bounce" but at a slow, regular rate.

BRIGHTNESS

The attribute of visual perception in accordance with which an area appears to emit more or less light.

Note: Luminance is recommended for the photometric quantity which has been called "brightness". Luminance is a purely photometric quantity. Use of this name permits "brightness" to be used entirely with reference to the sensory response. The photometric quantity has been often confused with the sensation merely because of the use of one name for two distinct ideas. Brightness will continue to be used, properly, in non-quantitative statements, especially with reference to sensations and perceptions of light. Thus, it is correct to refer to a brightness match, even in the field of a photometer, because the sensations are matched and only by inference are the photometric quantities (luminances) equal. Likewise, a photometer in which such matches are made will continue to be called an "equality-of-brightness" photometer. A photoelectric instrument, calibrated in foot-lamberts, should not be called a "brightness meter".

(continued on sheet 4)

NOTE (continued)

If correctly calibrated, it is a "luminance meter". A troublesome paradox is eliminated by the proposed distinction of nomenclature. The luminance of a surface may be doubled, yet it will be permissible to say that the brightness is not doubled, since the sensation which is called "brightness" is generally judged to be not doubled.

BURNED-IN IMAGE

An image which persists in a fixed position in the output signal of a camera tube after the camera has been turned to a different scene.

CAMERA TUBE (57 IRE 7.52)

An electron tube for the conversion of an optical image into an electrical signal by a scanning process.

CLAMPING

The process that establishes a fixed level for the picture level at the beginning of each scanning line.

COMPOSITE PICTURE SIGNAL (55 IRE 23.S1)

The signal which results from combining a Blanked Picture Signal with the Sync Signal.

COMPRESSION (in Television) (55 IRE 23.S1)

The reduction in gain at one Level of a Picture Signal with respect to the gain at another Level of the same signal.

Note 1: See also Black Compression and White Compression.

Note 2: The gain referred to in the definition is for a signal amplitude small in comparison with the total peak-to-peak Picture Signal involved. A quantitative evaluation of this effect can be obtained by a measurement of Differential Gain.

CONTRAST

The range of light and dark values in a picture or the ratio between the maximum and minimum brightness values.

DAMPED OSCILLATION

Any oscillation that decays to zero amplitude in a uniform manner upon removal of the driving force.

DEGREES OF IMPAIRMENTS

Television picture impairments may be present in varying degrees. In the case of oscilloscope presentations, most impairments can best be described to remote points by indicating the IRE scale readings of the various signal components. In the case of picture-monitor presentations, however, impairments generally must be described in qualitative terms rather than quantitative terms, and the exchange of intelligence between remote observers is more complicated. The following descriptive terms, without a sharp line of demarcation being possible, are in common usage for indicating the magnitude of impairments.

Detectable: Impairment is not readily noticeable in a normal picture or oscilloscope display but can be discerned by a minute inspection of the signal, it sometimes being necessary to vary picture-monitor brightness or expand oscilloscope presentations.

Noticeable: Impairment is readily observed in the viewed display.

Objectionable: Impairment interferes with the viewing of the display.

Unacceptable: Impairment is present to such a degree that the presentation or portion of the presentation is not usable.

DENSITY (56 IRE 9.S1)

A measure of the light-transmitting or reflecting properties of an area. It is expressed by the common logarithm of the ratio of incident to transmitted or reflected light flux.

Note: There are many types Density which will usually have different numerical values for a given material; e.g., Diffuse Density, Double Diffuse Density, Specular Density. The relevant type of density depends upon the geometry of the optical system in which the material is used.

DETAIL CONTRAST

The ratio of the amplitude of video signal representing high-frequency components with the amplitude representing the reference low-frequency component, usually expressed as a percentage at a particular line number.

DISPLACEMENT OF PORCHES

Refers to any difference between the level of the front porch and the level of the back porch.

DRIP-PROOF (of an enclosure)

Drip-proof means so constructed or protected that successful operation is not interfered with when falling drops of liquid or solid particles strike the enclosure at any angle from 0 to 15 degrees from the downward vertical, unless otherwise specified.

DRIPTIGHT

Driptight means so constructed or protected that drops of liquid or solid particles striking the enclosure at any angle from 0 to 15 degrees from the downward vertical, unless otherwise specified, cannot enter the enclosure either directly or by striking and running along a horizontal or inwardly-inclined surface.

DUSTPROOF

Dustproof means so constructed or protected that dust will not interfere with successful operation.

DUST-TIGHT

Dust-tight means so constructed that dust will not enter the enclosing case.

ECHO (or Reflection)

A wave which has been reflected at one or more points in the transmission medium with sufficient magnitude and time difference to be perceived in some manner as a wave distinct from that of the main or primary transmission. Echoes may be either leading or lagging the primary wave and appear in the picture monitor as reflections, or "ghosts".

EIA SYNC

The signal employed for the synchronizing of scanning shall be that specified in EIA Standard RS-170 or subsequent issues.

EXPLOSION-PROOF

Constructed in a manner to prevent the surrounding atmosphere from being exploded by the operation of, or the results from, operating the item so classified.

EXPLOSION-PROOF APPARATUS

Explosion-proof apparatus is apparatus enclosed in a case which is capable of withstanding an explosion of a specified gas or vapor which may occur within it, and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and it must operate at such an external temperature that a surrounding flammable atmosphere will not thereby be ignited.

FIELD FREQUENCY (55 IRE 23.S1)

The product of frame Frequency multiplied by the number of Fields contained in one Frame.

FOOTCANDLE (55 IRE 22.S1)

A unit of Illuminance when the foot is taken as the unit of length. It is the Illuminance on a surface one square foot in area on which there is a uniformly distributed flux of one Lumen, or the Illuminance at a surface all points of which are at a distance of one foot from a uniform source of one Candle.

FOOTLAMBERT (55 IRE 22.S1)

A unit of Luminance equal to 1/ Candle per square foot, or to the uniform Luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one Lumen per square foot.

Note: A Footcandle is a unit of incident light and a Footlambert is a unit of emitted or reflected light. For a perfectly reflecting and perfectly diffusing surface, the number of Footcandles is equal to the number of Footlamberts.

FRAME (in Television) (55 IRE 23.S1)

The total area, occupied by the picture, which is scanned while the Picture Signal is not blanked.

FREE-RUNNING FREQUENCY (52 IRE 17.S1)

The frequency at which a normally synchronized oscillator operates in the absence of a synchronizing signal.

FRONT PORCH (55 IRE 23.S1)

That portion of a Composite Picture Signal which lies between the leading edge of the horizontal blanking Pulse and the leading edge of the corresponding sync Pulse.

GAMMA (Picture or Camera Tubes) (57 IRE 7.S2)

The exponent of that power law which is used to approximate the curve of output magnitude vs input magnitude over the region of interest.

Note: For quantitative evaluation, it is customary to plot the log of the output magnitude (ordinate) vs the log of the input magnitude (abscissa), as measured from a point corresponding to some reference black level, and select a straight line which approximates this plot over the region of interest and takes its slope. If the plot departs seriously from linearity it cannot be adequately described by a single value of Gamma. Even when the plot is reasonably linear, the procedure for determining the approximation should be described.

GAMMA (Television) (55 IRE 22.S1)

In television, the exponent of that power law which is used to approximate the curve of output magnitude vs input magnitude over the region of interest.

Note: For quantitative evaluation it is customary to plot the log of the output magnitude (ordinate) vs the log of the input magnitude (abscissa), as measured from a point corresponding to some reference black level, and select a straignt line which approximates this plot over the region of interest and take its slope. If the plot departs seriously from linearity it cannot be adequately described by a single value of Gamma. Even when the plot is reasonably linear the procedure for determining the approximation should be prescribed.

GAMMA CORRECTION (55 IRE 22.S1)

The introduction of a nonlinear output-input characteristic for the purpose of changing the effective value of Gamma.

GEOMETRIC DISTORTION

Any aberration which causes the reproduced picture to be geometrically dissimilar to the perspective plane projection of the original scene.

GHOST

A shadowy or weak image in the received picture, offset to either the left or right of the primary image, the result of transmission conditions which create secondary signals that are received earlier or later than the main or primary signal. A ghost displaced to the left of the primary image is designated as "leading", and one displaced to the right is designated as "following" (lagging). When the tonal variations of the ghost are the same as the primary image, it is designated as "positive", and when it is the reverse, it is designated as "negative".

GLITCHES

A form of low-frequency interference appearing as a narrow horizontal bar moving vertically through the picture. This is also observed on an oscilloscope at field or frame rate as an extraneous voltage pip moving along the signal at approximately reference-black level.

HIGHLIGHTS

The maximum brightness of the picture, which occurs in regions of highest illumination.

HORIZONTAL BLANKING

The blanking signal at the end of each scanning line.

HORIZONTAL (HUM) BARS

Relatively broad horizontal bars, alternately black and white, which extend over the entire picture. They may be stationary or may move up or down. Sometimes referred to as a "venetian-blind" effect, it is caused by approximate 60-cycle interfering frequency or one of its harmonic frequencies.

HORIZONTAL RETRACE

The return of the electron beam from the right to the left side of the raster after the scanning of one line.

HUM (52 IRE 17.S1) (58 IRE 3.S1)

Electrical disturbance at the power supply frequency or harmonics thereof.

HUM MODULATION (52 IRE 17.S1)

Modulation of a radio frequency or detected signal by hum.

IMAGE DISSECTOR TUBE (DISSECTOR TUBE) (57 IRE 7.S2)

A Camera Tube in which an electron image produced by a photo-emitting surface is focused in the plane of a defining aperture and is scanned past that aperture.

IMAGE ICONOSCOPE (57 IRE 7.S2)

A Camera Tube in which an electron image is produced by a photo-emitting surface and focused on one side of a separate storage Target which is scanned on the same side by an electron beam, usually of high-velocity electrons.

IMAGE ORTHICON (57 IRE 7.S2)

A Camera Tube in which an electron image is produced by a photo-emitting surface and focused on one side of a separate storage Target which is scanned on its opposite side of an electron beam, usually of low-velocity electrons.

IMAGE TUBE (Image Converter Tube) (57 IRE 7.S2)

An Electron Tube which reproduces on its fluorescent screen an image of an irradiation pattern incident on its photo-sensitive surface.

INDOOR (used as a prefix)

The prefix indoor means not suitable for exposure to the weather.

INTERFERENCE (General, 52 IRE 17.S1)

In a signal transmission system either extraneous power which tends to interfere with the reception of the desired signals, or the disturbance of signals.

INTERLACED SCANNING (55 IRE 23.S1)

A scanning process in which the distance from center to center of successively scanned lines is two or more times the nominal line width, and in which the adjacent lines belong to different Fields.

ION

A charged atom, usually an atom of residual gas in an electron tube.

ION SPOT

A spot on the fluorescent surface of a cathode-ray tube which is somewhat darker than the surrounding area because of bombardment by negative ions which reduce the sensitivity.

ION TRAP

An arrangement of magnetic fields and apertures which will allow an electron beam to pass through but will obstruct the passage of ions.

IRE ROLL-OFF

The IRE standard oscilloscope frequency-response characteristic for measurement of level. This characteristic is such that at 2 mc the response is approximately 3.5 db below that in the flat (low-frequency) portion of the spectrum and cuts off slowly.

JITTER (54 IRE 12.S1)

Small rapid variations in a waveform due to mechanical disturbances or to changes in the supply voltages, in the characteristic of components, etc.

LAG (Camera Tubes) (57 IRE 7.S2)

A persistence of the electrical-charge image for a small number of frames.

LAMBERT (55 IRE 22.S1)

A unit of Luminance equal to 1/ Candle per square centimeter, and, therefore, equal to the uniform Luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one Lumen per square centimeter.

LUMEN (55 IRE 22.S1)

The unit of luminous flux. It is equal to the flux through a unit solid angle (steradian) from a uniform point source of one Candle, or to the flux on a unit surface all points of which at unit distance from a uniform point source of one Candle.

MICROPHONICS (58 IRE 3.S1)

Audio-Frequency Noise caused by mechanical vibration of elements in a system or component.

MOIRE

A wavy or satiny effect producted by convergence of lines. Usually appears as a curving of the lines in the horizontal wedges of the test pattern and is most pronounced near the center where the lines forming the wedges converge. A moire pattern is a natural optical effect when converging lines in the picture are nearly parallel to the scanning lines. To a degree this effect is sometimes due to the characteristics of color picture tubes and of image-orthicon pickup tubes (in the latter termed "mesh beat").

MOISTURE-REPELLENT

Moisture-repellent means so constructed or treated that moisture will not penetrate.

MOISTURE-RESISTANT

Moisture-resistant means so constructed or treated that exposure to a moist atmosphere will not readily cause malfunction.

MONOCHROME (55 IRE 22.S1)

Having only one Chromaticity, usually achromatic.

MONOCHROME (Signal. 1) (55 Ire 22.S1)

In monochrome television, a signal wave for controlling the Luminance values in the picture. 2) In color television, that part of the signal wave which has major control of the Luminance values of the picture, whether displayed in Color or in Monochrome.

MONOSCOPE (52 IRE 17.S1; 57 IRE 7.S2)

A signal-generating Electron-Beam Tube in which a picture signal is produced by scanning an Electrode which has a predetermined pattern of Secondary-Emission response over its surface.

NEGATIVE IMAGE

Refers to a picture signal having a polarity which is opposite to normal polarity and which results in a picture in which the white areas appear as black and vice versa.

ORTHICON (57 IRE 7.S2)

A Camera Tube in which a beam of low-velocity electrons scans a photo-emissive mosaic capable of storing an electrical-charge pattern.

OUTDOOR (used as a prefix)

The prefix outdoor means designed for outdoor service.

PAIRING

A partial or complete failure of interlace in which the scanning lines of alternate fields do not fall exactly between one another but tend to fall (in pairs) one on top of the other.

PHOTOCATHODE (57 IRE 7.S2)

An Electrode used for obtaining Photoelectric Emission.

PICTURE TUBE (Kinescope) (50 IRE 7.S1)

A cathode-ray tube used to produce an image by variation of the beam intensity as the beam scans a raster.

POLARITY OF PICTURE SIGNAL (55 IRE 23.S1)

The sense of the potential of a portion of the signal representing a dark area of a scene relative to the potential of a portion of the signal representing a light area. Polarity is stated as "black negative" or "black positive".

PREAMPLIFIER. 1)

An Amplifier, the primary function of which is to raise the output of a low-level source to an intermediate level so that the signal may be further processed without appreciable degradation in the signal-to-noise ratio of the system.

PROOF (used as a suffix)

Apparatus is designated as splashproof, dustproof, etc., when so constructed, protected, or treated that its successful operation is not interfered with when subjected to the specified material or condition.

PULSE RISE TIME (51 IRE 20.S1)

The interval between the instants at which the instantaneous amplitude first reaches specified lower and upper limits, namely, 10 per cent and 90 per cent of the peak-pulse amplitude unless otherwise stated.

RAINTIGHT

Raintight means so constructed or protected that exposure to a beating rain will not result in the entrance of water.

RANDOM INTERLACE

In random interlace there is no fixed relationship between adjacent lines and successive fields.

RASTER (57 IRE 7.S2)

A predetermined pattern of scanning lines which provides substantially uniform coverage of an area.

RASTER BURN (Camera Tubes) (57 IRE 7.S2)

A change in the characteristics of that area of the Target which has been scanned, resulting in a spurious signal corresponding to that area when a larger or tilted Raster is scanned.

REFERENCE BLACK LEVEL (55 IRE 23.S1)

The Picture Signal Level corresponding to a specified maximum limit for Black Peaks.

REFERENCE WHITE LEVEL (55 IRE 23.S1)

The Picture Signal Level corresponding to a specified maximum limit for White Peaks.

RESISTANT (used as a suffix)

Apparatus is designated as moisture-resistant, fume-resistant, etc., when so constructed, protected, or treated that it will not be injured readily when subjected to the specified material or condition.

RESOLUTION (Horizontal)

The amount of resolvable detail in the horizontal direction in a picture. It is usually expressed as the number of distinct vertical lines, alternately black and white, which can be seen in a distance equal to picture height.

This information usually is derived by observation of the vertical wedge of a test pattern. A picture which is sharp and clear and shows small details has good, or high, resolution. If the picture is soft and blurred and small details are indistinct, it has poor, or low resolution. Horizontal resolution depends upon the high-frequency amplitude and phase response of the pickup equipment, the transmission medium and the picture monitor as well as the size of the scanning spots.

RESOLUTION (Vertical)

The amount of resolvable detail in the vertical direction in a picture. It is usually expressed as the number of distinct horizontal lines, alternately black and white, which can be seen in a test pattern.

Vertical resolution is fundamentally limited by the number of horizontal scanning lines per frame. Beyond this, vertical resolution depends on the size and shape of the scanning spots of the pickup equipment and picture monitor and does not depend upon the high-frequency response or bandwidth of the transmission medium or picture monitor.

RETAINED IMAGE (Image Burn) (57 IRE 7.S2)

A change produced in or on the Target which remains for a large number of frames after the removal of a previously stationary light image and which yields a spurious electrical signal corresponding to that light image.

RINGING (in Receivers) (52 IRE 17.S1)

An oscillatory transient occurring in the output of a system as a result of a sudden change in input.

RISE TIME

(See Pulse Rise Time)

SENSITIVITY (of a Camera Tube) (50 IRE 7.S1)

The signal current developed per unit incident radiation density, (i.e., per watt per unit area). Unless otherwise specified, the radiation is understood to be that of unfiltered incandescent source of 2870°K, and its density, which is generally measured in watts per unit area, may then be expressed in foot-candles.

SHADING

A large area brightness gradient in the reproduced picture, not present in the original scene.

SIGNAL-to-NOISE RATIO (48 IRE 2, 11, 15.S1)

The ratio of the value of the signal to that of the noise.

Note 1: This ratio is usually in terms of peak values in the case of impulse noise and in terms of the root-mean-square values in the case of random noise.

Note 2: Where there is a possibility of ambiguity, suitable definitions of the signal and noise should be associated with the term; as, for example: peak-signal to peak-noise ratio; root-mean-square signal to root-mean-square noise ratio; peak-to-peak signal to peak-to-peak noise ratio, etc.

Note 3: This ratio is often expressed in decibels.

Note 4: This ratio may be a function of the bandwidth of the transmission system.

SIGNAL-to-NOISE RATIO (Camera Tubes) (57 IRE 7.S2)

The ratio of peak-to-peak Signal Output Current to rms noise in the output current.

SLEETPROOF

Sleetproof means so constructed or protected that the accumulation of sleet will not interfere with successful operation.

SPLASHPROOF

Splashproof means so constructed and protected that external splashing will not interfere with successful operation.

SPLASHRESISTANT

Splahsresistant means so constructed or protected that exposure to external splashing will not readily cause malfunction.

SPLASHTIGHT

Splashtight means so constructed or protected that exposure to external splashing will not result in the entrance of moisture.

SQUARE-WAVE RESPONSE (Camera Tubes) (57 IRE 7.S2)

The ratio of 1) the peak-to-peak signal amplitude given by a test pattern consisting of alternate black and white bars of equal widths to 2) the difference in signal between large-area blacks and large-area whites having the same illuminations as the black and white bars in the test pattern.

Note: Horizontal Square-Wave Response is measured if the bars run perpendicular to the direction of horizontal scan. Vertical Square-Wave Response is measured if the bars run parallel to the direction of horizontal scan.

STREAKING

A term used to describe a picture condition in which objects appear to be extended horizontally beyond their normal boundaries. This will be more apparent at vertical edges of objects when there is a large transition from black to white or white to black. The change in luminance is carried beyond the transition and may be either negative or positive. For example, if the tonal degradation is an opposite shade to the original figure (white following black), the streaking is called negative; however, if the shade is the same as the original figure (white following white), the streaking is called positive. Streaking is usually expressed as short, medium, or long streaking. Long streaking may extend to the right edge of the picture and, in extreme cases of low-frequency distortion, can extend over a whole line interval.

SUBMERSIBLE

(Immersible)* *Deprecated. - Submersible means so constructed as to be successfully operable when submerged in water under specified conditions of pressure and time.

SYNC COMPRESSION

The reduction in the amplitude of the sync signal, with respect to the picture signal, occurring between two points of a circuit.

SYNCHRONIZING (in Television) (55 IRE 23.S1)

Maintaining two or more scanning processes in phase.

SYNC LEVEL (55 IRE 23.S1)

The Level of the peaks of the Sync Signal.

SYNC SIGNAL (Synchronizing Signal) (55 IRE 23.S1)

The signal employed for the synchronizing of scanning.

Note: In television, this signal is composed of Pulses at rates related to the line and field frequencies.

(continued on sheet 17)

MOTOROLA
COMMUNICATION and ELECTRONICS, INC.

CA2-VI-B

TECHNICAL
TRAINING
DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VI – SECTION B
THEORY OF OPERATION

For detailed theory of operation on the various models, the student is advised to refer to the appropriate instruction manuals in part VI Section I of this course material.

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CA2-VI-C
TECHNICAL
TRAINING
DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VI – SECTION C
LOCKED INTERLACE

MODEL S1140A-VSP02

LOCKED INTERLACE CAMERA

1. INTRODUCTION

This camera is a modified version of the Model S1140A, described in Instruction Manual 68P81048A90. The camera uses an additional printed circuit board, shown on Detail 2-VSP551181, which provides a "locked sync" option to the S1140A Camera. The board circuitry is completely integrated with the exception of two resistors and 2 capacitors. Plug-in wire connectors provide easy removal and/or replacement of the board. Following is a description of locked and random interlace systems.

2. DESCRIPTION

a. Locked Interlace

In the closed circuit television industry, "locked interlace", "positive interlace", "2:1 interlace", and "industrial sync" are synonymous terms. Although the terms are used interchangeably (depending on the manufacturer or person describing the equipment), the synchronizing waveforms that fit these descriptions are not identical. The only thing in common is a fixed relationship between the horizontal and vertical synchronizing rates which is a ratio of 262.5 horizontal lines to 1 vertical line. This fixed relationship is intended to assure that the two fields which comprise one TV frame are accurately and consistently interlaced.

b. Random Interlace

This system differs from locked interlace only in that a fixed relationship between horizontal and vertical synchronizing rates does not exist. This relationship is allowed to vary slightly and therefore, accurate interlace is not achieved. In high quality CCTV equipment, the effect of moving from locked interlace to random interlace is a slight decrease in vertical resolution, in the order of 15%. The horizontal resolution is not effected, therefore, total system resolution is only slightly effected. Random interlace has, for all practical purposes, a disadvantage over other synchronizing systems only when an alpha-numeric data is being televised. Even in this specific application the slight degradation in performance is hardly noticeable unless narrow horizontal lines must be displayed.

3. THEORY OF OPERATION

Refer to Diagrams 3-VSP551181 and 4-VSP551181.

The horizontal synchronizing rate is developed from a 31.5 KHz crystal-controlled multivibrator (Q40 and Q41) in the camera. This multivibrator feeds

two other circuits. First the 31.5 KHz signal goes to a "divide-by-two" multivibrator (Q46 and Q47). This circuit provides the horizontal synchronizing rate (15,750 Hz). The second output serves to drive the "locked sync" board. This board then provides the vertical synchronizing rate output (60 Hz). Thus, both the vertical and horizontal synchronizing rates are obtained from one source and exist in a fixed relationship to each other.

The locked-sync circuit basically consists of six amplifiers and twelve JK flip flops. These circuits are combined so that the circuit essentially consists of four counter stages. These counters are, a "divide-by-seven" (MOD 7), two "divide-by-five" (MOD 5), and a "divide-by-three" (MOD 3). This division process, (7 x 5 x 5 x 3 = 525) establishes a fixed relationship between the 31.5 KHz and the 60 Hz.

4. SERVICING

Two things must be considered when servicing the locked-sync board. First, integrated circuits are simpler to troubleshoot them discrete circuits, and second, it is rare when an integrated circuit is defective.

Servicing techniques for integrated circuits are similar to the discrete circuits. In discrete circuits the attempt is to first locate the defective circuit, then the defective component. In integrated circuitry, just locate the defective circuit.

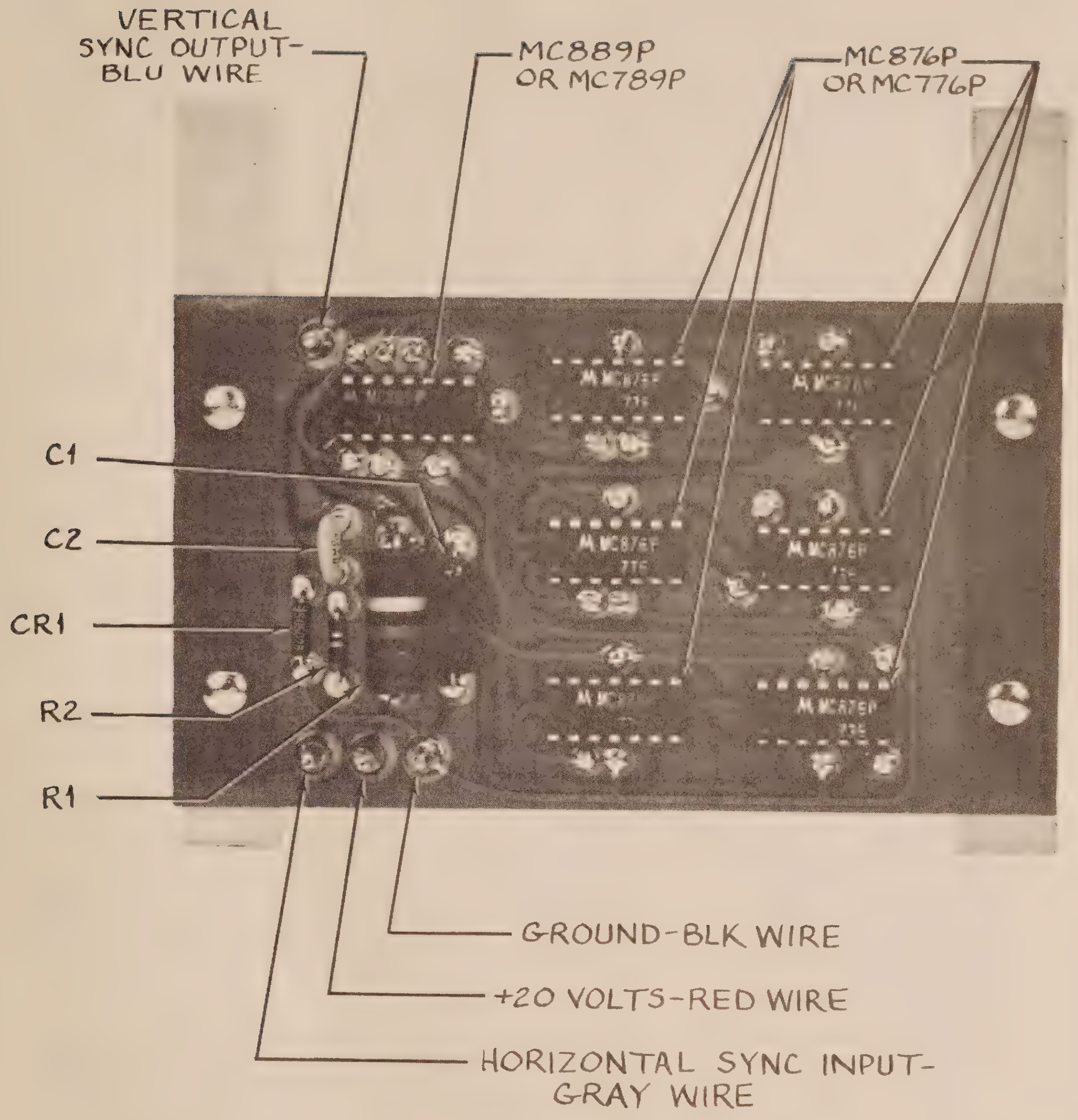
When servicing the locked-sync board, make sure the 31.5 KHz signal is present at the input to the 15K-ohm resistor. Then check with a high-quality oscilloscope for the presence of a 60 Hz output. If present, the board is functioning correctly.

To determine if an inverter amplifier is functioning properly, use an oscilloscope to check for presence of input signal. If present, there should be an output signal. If no output signal is present, check the V_{cc} and ground. If correct readings are measured, (V_{cc} and ground) then the inverter amplifier is probably defective.

The operation of the JK flip flops in the counter stages is simple to determine. To obtain an output from the flip flop, five inputs are required. These inputs are: V_{cc}, ground, and pulse inputs on the S, T, and C terminals. Refer to Diagram 3-VSP551181. If readings are correct, there should be an output on the 1 and 0 terminals. If no outputs exist, then the circuit is probably defective.

NOTE

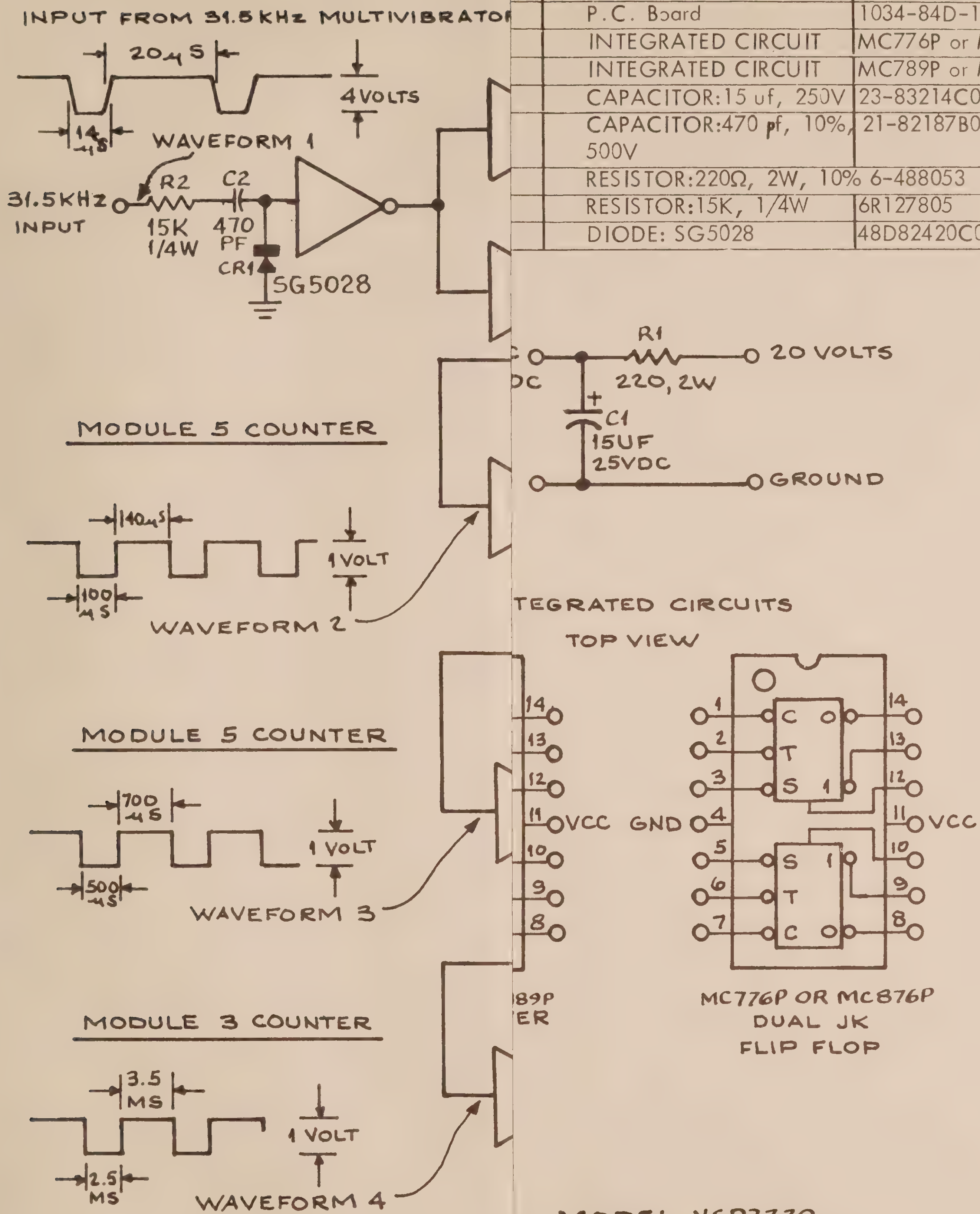
Great care must be taken when replacing an integrated circuit. Use a low wattage soldering iron (37 watt).



MODEL VSP3330
LOCKED SYNC BOARD DETAIL
MOTOROLA NO. 2-VSP551181-2
11/14/67

PARTS LIST

	DESCRIPTION	PART NO.
	P.C. Board	1034-84D-1
	INTEGRATED CIRCUIT	MC776P or MC 876P
	INTEGRATED CIRCUIT	MC789P or MC 889P
	CAPACITOR:15 uf, 250V	23-83214C02
	CAPACITOR:470 pf, 10%, 500V	21-82187B07
	RESISTOR:220Ω, 2W, 10%	6-488053
	RESISTOR:15K, 1/4W	6R127805
	DIODE: SG5028	48D82420C05



NOTE :

ALL WAVEFORM MEASUR

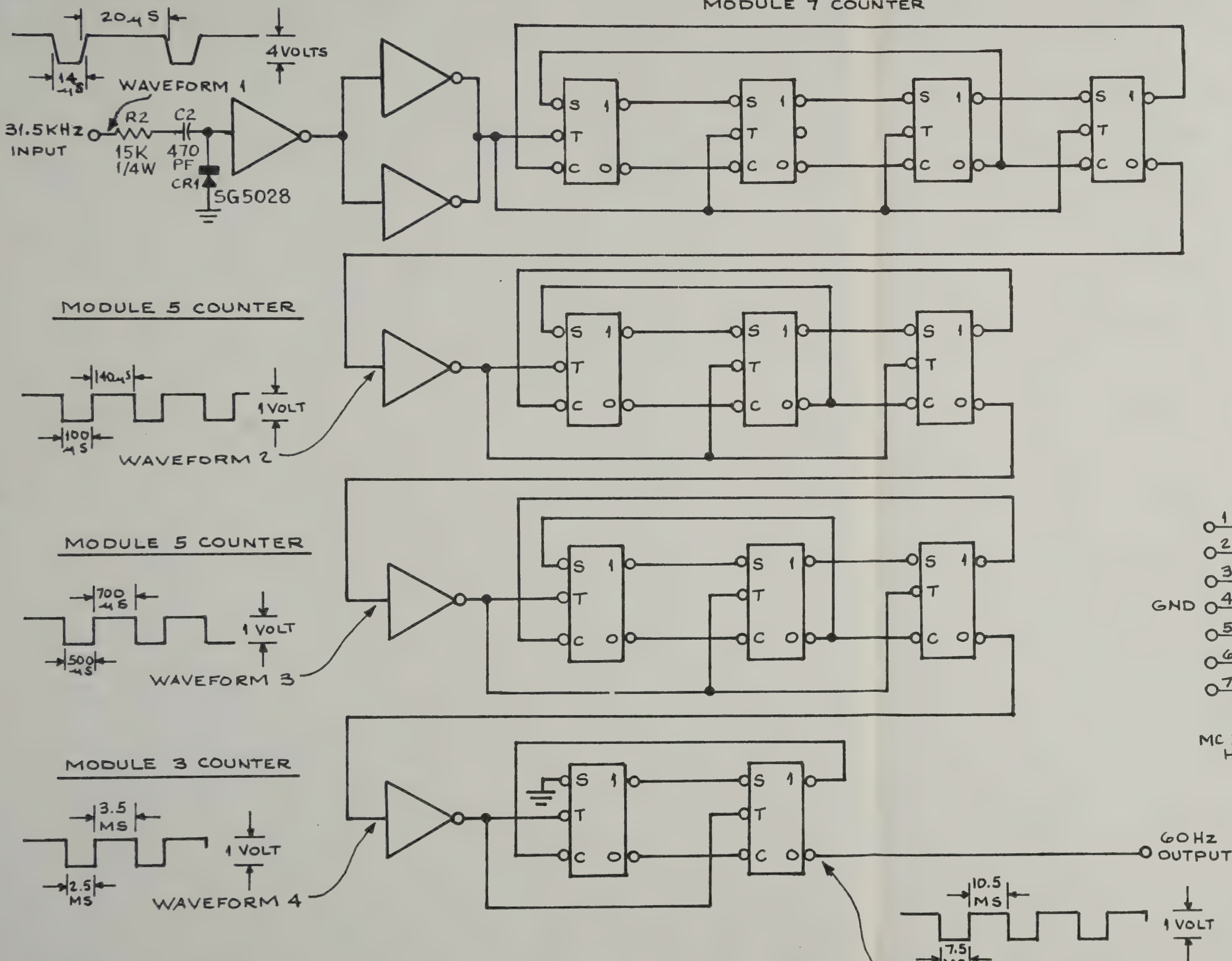
MODEL VSP3330

LOCKED SYNC BOARD

CIRCUIT DIAGRAM & WAVEFORMS

MOTOROLA NO.3-VSP551181-3

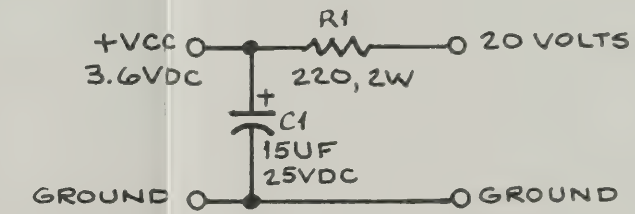
10-26-67



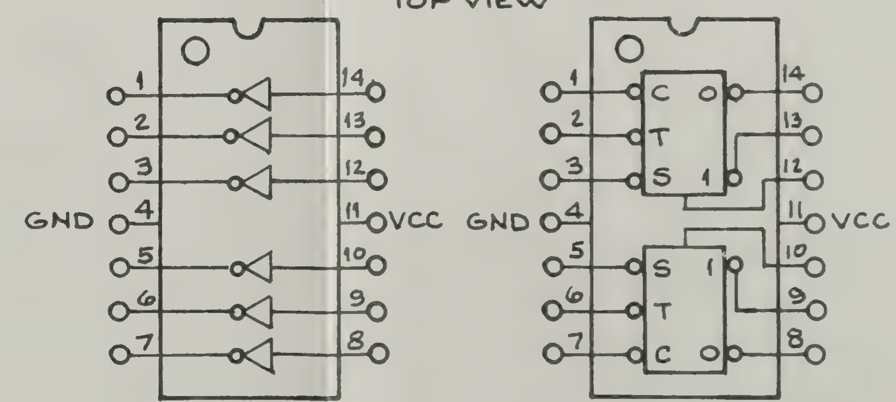
NOTE :
ALL WAVEFORM MEASUREMENTS ARE ±10%.

PARTS LIST

REFERENCE	DESCRIPTION	PART NO.
	P.C. Board	1034-84D-1
	INTEGRATED CIRCUIT	MC776P or MC 876P
	INTEGRATED CIRCUIT	MC789P or MC 889P
C1	CAPACITOR:15 uf, 250V	23-83214C02
C2	CAPACITOR:470 pf, 10%, 500V	21-82187B07
R1	RESISTOR:220Ω, 2W, 10%	6-488053
R2	RESISTOR:15K, 1/4W	6R127805
CR1	DIODE: SG5028	48D82420C05



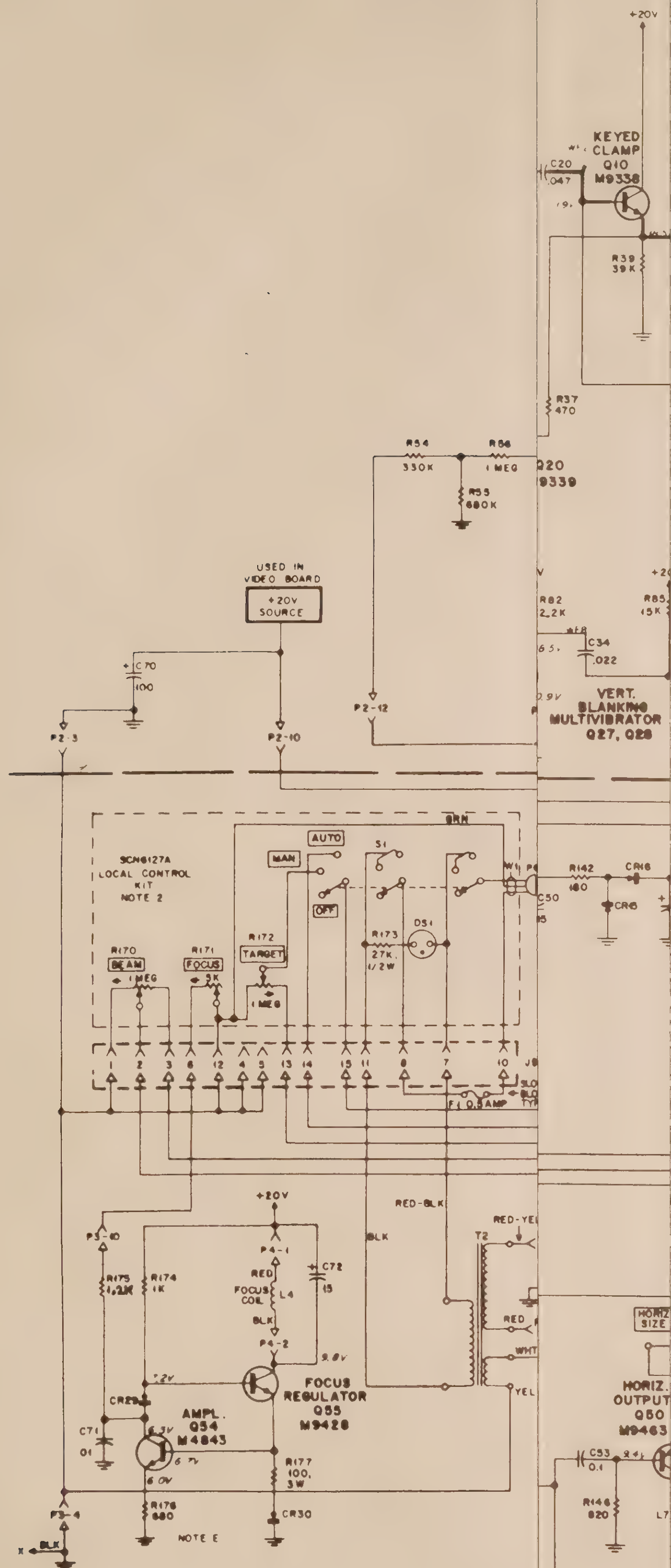
INTEGRATED CIRCUITS
TOP VIEW



MC 789P OR MC889P
HEX INVERTER

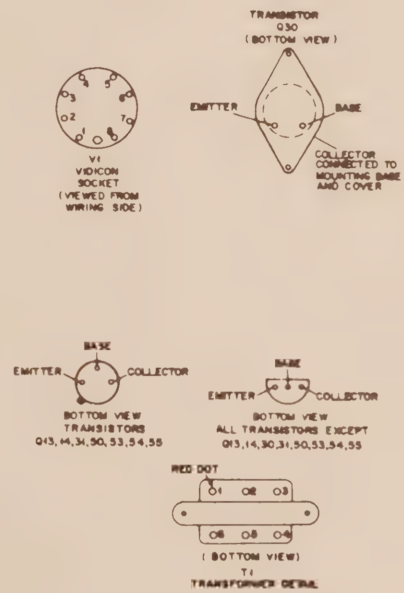
MC776P OR MC876P
DUAL JK
FLIP FLOP

MODEL VSP3330
LOCKED SYNC BOARD
CIRCUIT DIAGRAM & WAVEFORMS
MOTOROLA NO.3-VSP551181-3
10-26-67

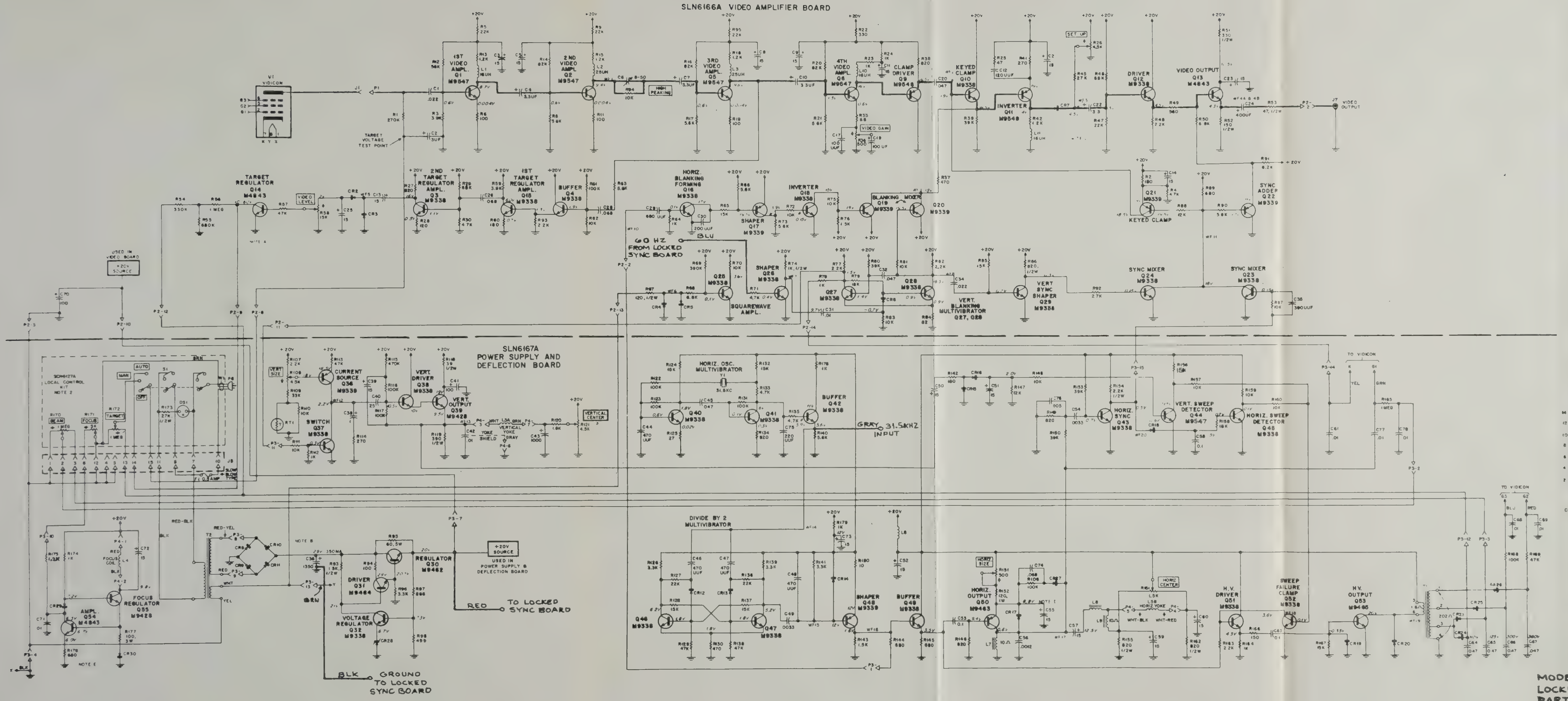


NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. COMPONENTS LOCATED ON LOCAL OR REMOTE CONTROL UNIT
3. DIRECTION ARROWS ON CONTROLS DENOTE CLOCKWISE ROTATION
4. EXPLANATION OF CIRCUIT BOARD EDGE-CONNECTIONS
   A. P2 = VIDEO AMPLIFIER BOARD (MATES WITH J2).
   B. P3 = POWER SUPPLY AND DEFLECTION BOARD. (MATES WITH J3).
   C. P1 = VIDICON TARGET.
   D. P4 = YOKE COILS. (MATES WITH J4)
5. REFER TO STANDARD MANUAL FOR CAMERA WAVEFORMS AND VOLTAGE READINGS.



S1140A-VSP02
SYNC CAMERA
SCHEMATIC DIAGRAM
ROLA NO. 4-VSP551181-1
67



NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. COMPONENTS LOCATED ON LOCAL OR REMOTE CONTROL UNIT
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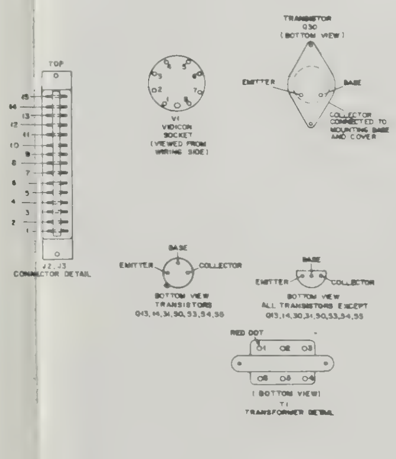
   C. P1 = VIDICON TARGET
   D. P4 = YOKE COILS (MATES WITH J4)
5. REFER TO STANDARD MANUAL FOR CAMERA WAVEFORMS AND VOLTAGE READINGS.



MODEL S1140A-VSP02
LOCKED SYNC CAMERA
PARTIAL SCHEMATIC DIAGRAM
MOTOROLA NO. 4-VSP55118I-1
7-25-67

MOTOROLA
COMMUNICATION and ELECTRONICS, INC.

CA2-VI-D

TECHNICAL TRAINING DEPARTMENT

PART VI – SECTION D

CLOSED CIRCUIT TELEVISION... SYSTEM PLANNERS

SYSTEM PLANNERS

GENERAL

Up to 500 feet - use RG59B/U Coaxial Cable (Model SKN6111A) only when cable will be installed alone in metal conduit, or when it will be installed in an area with a very low electro-magnetic field strength from interference sources such as broadcast radio and television transmitters, and power lines. Uses male UHF connectors in Kit SLN6154A which consists of two connectors.

Up to 3000 feet - use Motorola SKN6112A Double-Shielded Polyfoam Coaxial Cable. The Motorola camera and monitor provide at least 800 lines of system horizontal resolution with cable lengths of up to 1000 feet; 650 lines of system horizontal resolution with cable lengths of up to 1500 feet; 500 lines of system horizontal resolution with 3000 feet of cable, without adding a line amplifier and/or equalizer unit to the system.

Coaxial and control cables can be supplied in continuous lengths up to 2000 ft. (1000 ft. for RG59B/U Coaxial Cable). For greater lengths, use a Motorola Model SLN6139A Weatherproof Cable Termination Unit to make a splice with the additional cable length. These systems are for coaxial and control cable lengths up to 3000 feet. For greater lengths, contact CCTV Marketing Department.

The Motorola 14-inch monitor is used in all systems because the operator is normally near the monitor, and this size is the optimum for close viewing. However, in those cases where the operator will be more than approximately 8-feet from the monitor, it may be desirable to use the Motorola Model S1127A 27-inch Video Monitor.

SIMPLIFIED CONDUIT SIZE CALCULATION GUIDE

The following tables have been prepared to help determine conduit requirements for any combination of Motorola CCTV coaxial and control cables. The conduit size derived from these charts will be adequate to permit easy cable pulling and will comply with National Electrical Code requirements.

TABLE 1 - National Electrical Code, Percent of allowable conduit fill.

CONDUIT SIZE (Inches)	ACTUAL INSIDE DIAMETER (Inches)	TOTAL CONDUIT AREA (Square Inches)	USEABLE CONDUIT AREA (Square Inches)
1/2	0.622	.30	.12
3/4	0.824	.53	.21
1	1.049	.86	.34
1-1/4	1.380	1.50	.60
1-1/2	1.610	2.04	.82
2	2.067	3.36	1.34
2-1/2	2.469	4.79	1.92
3	3.068	7.38	2.95

TABLE 2 - Coaxial and Control Cables used in CCTV systems and respective cable diameters and cross-sectional areas.

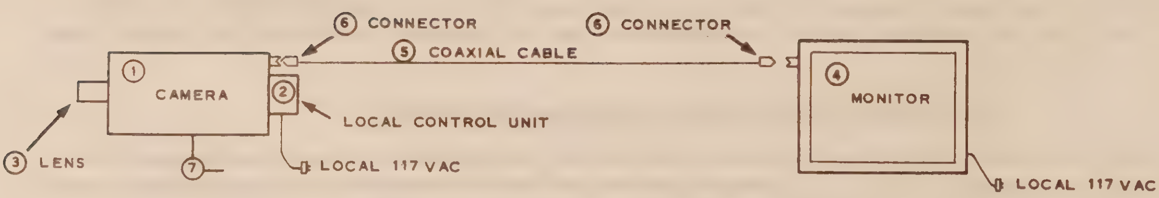
KIT NO.	CABLE DESCRIPTION	CABLE DIAMETER (Inches)	CABLE AREA (Square Inches)
SKN6111A	RG59B/U Coaxial	.265	.055
SKN6112A	Double-Shielded Polyfoam Coaxial	.500	.196
SKN6113A	9 Conductor Control	.600	.283
SKN6114A	16 Conductor Control	.635	.317
SKN6115A	23 Conductor Control	.675	.358

Procedure: Step 1 - Determine cable(s) to be pulled in conduit.
Step 2 - Refer to Table 2 to determine the Cable Area. If more than one of a given cable type is used, multiply the Cable Area by the quantity of that cable.
Step 3 - Add the Cable Areas for all cables.
Step 4 - Refer to Table 1 to determine conduit size by locating the Useable Conduit Area which equals or just exceeds the total found in Step 3 (above).

NOTE! Contact factory B & Q for systems using VSP1000, Camera system.

SYSTEM I - FIXED RANDOM INTERLACE & LOCKED SYNC CAMERA - LOCAL CAMERA CONTROLS

PURPOSE: This system is used in those applications where the camera is easily accessible for occasional touch-up adjustments. All primary camera controls are on the rear of the camera.



ORDERING INFORMATION

Item No.	Model No.	Equipment Description
1.	S1120C or S1120C-VSP50	Indoor Random Interlace Camera Indoor Locked Sync Camera with self-contained sync generator
2.	SCN6109A	Local Control Unit
3.	SLN614?A	Lens, (?)-Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	SKN6112A	Double-Shielded Polyfoam Coaxial Cable (specify length of cable in feet)
6.	SLN6155A	Male UHF Connectors (consists of two connectors)
7.	VSP-020-95	Indoor Camera Mount (optional; standard 1/4-20 mounting hole in base of camera)

(Continued on following page)

SYSTEM PLANNERS

GENERAL

Up to 500 feet - use RG59B/U Coaxial Cable (Model SKN6111A) only when cable will be installed alone in metal conduit, or when it will be installed in an area with a very low electro-magnetic field strength from interference sources such as broadcast radio and television transmitters, and power lines. Uses male UHF connectors in Kit SLN6154A which consists of two connectors.

Up to 3000 feet - use Motorola SKN6112A Double-Shielded Polyfoam Coaxial Cable. The Motorola camera and monitor provide at least 800 lines of system horizontal resolution with cable lengths of up to 1000 feet; 650 lines of system horizontal resolution with cable lengths of up to 1500 feet; 500 lines of system horizontal resolution with 3000 feet of cable, without adding a line amplifier and/or equalizer unit to the system.

Coaxial and control cables can be supplied in continuous lengths up to 2000 ft. (1000 ft. for RG59B/U Coaxial Cable). For greater lengths, use a Motorola Model SLN6139A Weatherproof Cable Termination Unit to make a splice with the additional cable length. These systems are for coaxial and control cable lengths up to 3000 feet. For greater lengths, contact CCTV Marketing Department.

The Motorola 14-inch monitor is used in all systems because the operator is normally near the monitor, and this size is the optimum for close viewing. However, in those cases where the operator will be more than approximately 8-feet from the monitor, it may be desirable to use the Motorola Model S1127A 27-inch Video Monitor.

SIMPLIFIED CONDUIT SIZE CALCULATION GUIDE

The following tables have been prepared to help determine conduit requirements for any combination of Motorola CCTV coaxial and control cables. The conduit size derived from these charts will be adequate to permit easy cable pulling and will comply with National Electrical Code requirements.

TABLE 1 - National Electrical Code, Percent of allowable conduit fill.

CONDUIT SIZE (Inches)	ACTUAL INSIDE DIAMETER (Inches)	TOTAL CONDUIT AREA (Square Inches)	USEABLE CONDUIT AREA (Square Inches)
1/2	0.622	.30	.12
3/4	0.824	.53	.21
1	1.049	.86	.34
1-1/4	1.380	1.50	.60
1-1/2	1.610	2.04	.82
2	2.067	3.36	1.34
2-1/2	2.469	4.79	1.92
3	3.068	7.38	2.95

TABLE 2 - Coaxial and Control Cables used in CCTV systems and respective cable diameters and cross-sectional areas.

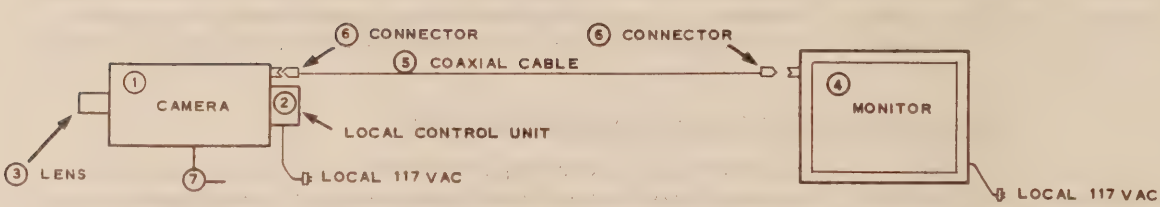
KIT NO.	CABLE DESCRIPTION	CABLE DIAMETER (Inches)	CABLE AREA (Square Inches)
SKN6111A	RG59B/U Coaxial	.265	.055
SKN6112A	Double-Shielded Polyfoam Coaxial	.500	.196
SKN6113A	9 Conductor Control	.600	.283
SKN6114A	16 Conductor Control	.635	.317
SKN6115A	23 Conductor Control	.675	.358

Procedure:
Step 1 - Determine cable(s) to be pulled in conduit.
Step 2 - Refer to Table 2 to determine the Cable Area. If more than one of a given cable type is used, multiply the Cable Area by the quantity of that cable.
Step 3 - Add the Cable Areas for all cables.
Step 4 - Refer to Table 1 to determine conduit size by locating the Useable Conduit Area which equals or just exceeds the total found in Step 3 (above).

NOTE! Contact factory B & Q for systems using VSP1000, Camera system.

SYSTEM I - FIXED RANDOM INTERLACE & LOCKED SYNC CAMERA - LOCAL CAMERA CONTROLS

PURPOSE: This system is used in those applications where the camera is easily accessible for occasional touch-up adjustments. All primary camera controls are on the rear of the camera.



ORDERING INFORMATION

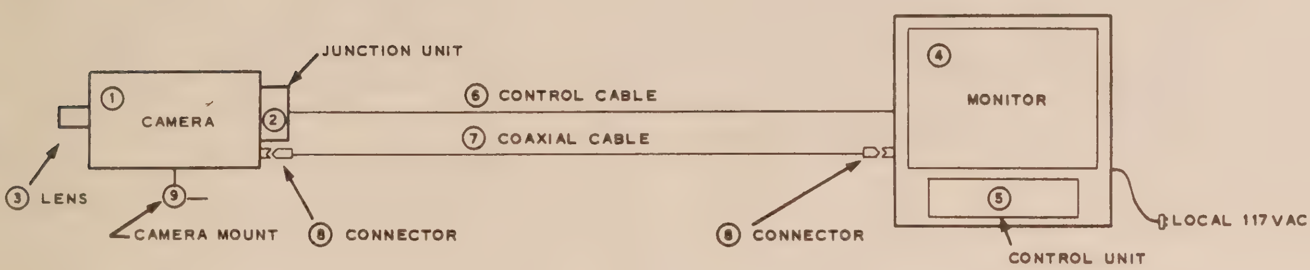
Item No.	Model No.	Equipment Description
1.	S1120C or S1120C-VSP50	Indoor Random Interlace Camera Indoor Locked Sync Camera with self-contained sync generator
2.	SCN6109A	Local Control Unit
3.	SLN614?A	Lens, (?)-Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	SKN6112A	Double-Shielded Polyfoam Coaxial Cable (specify length of cable in feet)
6.	SLN6155A	Male UHF Connectors (consists of two connectors)
7.	VSP-020-95	Indoor Camera Mount (optional; standard 1/4-20 mounting hole in base of camera)

(Continued on following page)

SYSTEM PLANNERS

SYSTEM II - FIXED RANDOM INTERLACE & LOCKED SYNC CAMERA-REMOTE CAMERA CONTROLS

PURPOSE: This system provides remote control of primary camera controls, and is recommended when the camera is not easily accessible, is in a protective enclosure, or when manual light controls may improve an unusual scene. A.C. power for the camera is provided via the control cable.



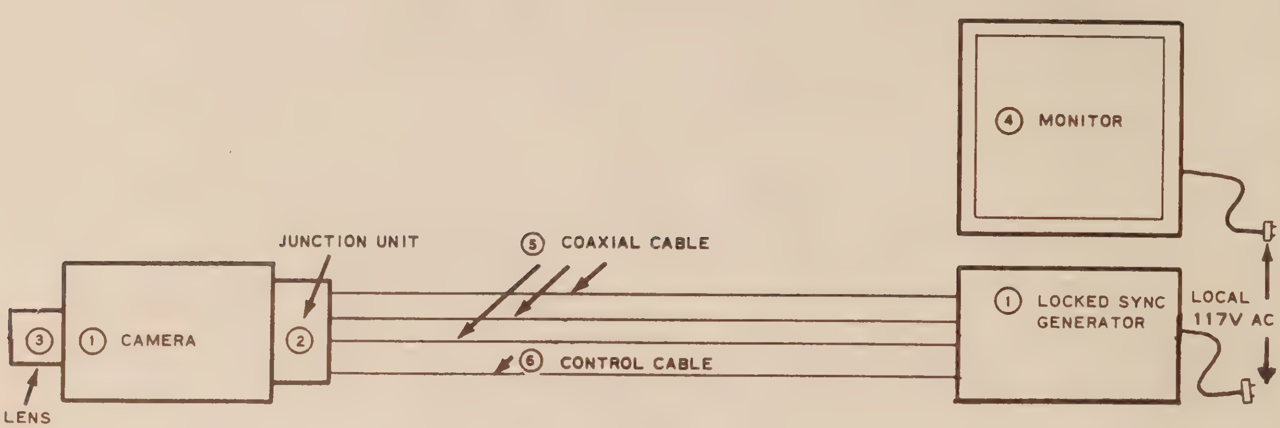
ORDERING INFORMATION

Item No.	Model No.	Equipment Description
1.	S1120C or S1120C-VSP50 or S1121C or S1122C	Indoor Random Interlace Camera Indoor Locked Sync Camera with self-contained sync generator Dust-Tight and Explosionproof Random Interlace Camera All-Weather Random Interlace Camera
2.	SLN6156A	Junction Unit
3.	SLN614?A	Lens, (?)-Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	SCN6122A	Camera Control Unit
6.	SKN6113A	9-Conductor Control Cable (specify length of cable in feet)
7.	SKN6112A	Double-Shielded Polyfoam Coaxial Cable (specify length of cable in feet)
8.	SLN6155A	Male UHF Connectors (consists of two connectors)
9.	VSP-020-95	Indoor Camera Mount (indoor camera only)

SYSTEM PLANNERS

SYSTEM III - FIXED LOCKED SYNC CAMERA - REMOTE CAMERA CONTROLS

GENERAL: The locked sync generator can be separated up to 1000 feet from the camera.



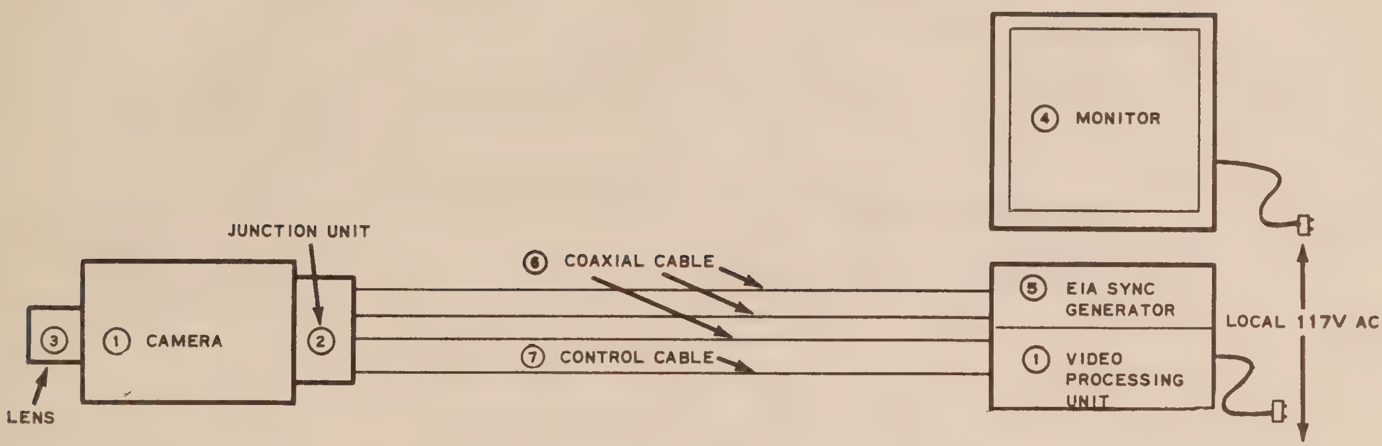
ORDERING INFORMATION

Item No.	Model No.	Equipment Description
1.	S1122C-VSP50 or S1121C-VSP50	All-Weather Locked Sync Camera with separate locked sync generator (includes camera controls). Dust-Tight and Explosionproof Locked Sync Camera with separate locked sync generator (includes camera controls).
2.	SLN6156A	Junction Unit
3.	SLN614?A	Lens, (?) - Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	SKN6111A and SKN6112A	RG59B/U Coaxial Cable (two cables required - specify length of cable). Double-Shielded Polyfoam Coaxial Cable (one cable required - specify length of cable).
6.	SKN6113A	9-Conductor Control Cable (specify length of cable)

SYSTEM PLANNERS

SYSTEM IV - FIXED EIA SYNC CAMERA - REMOTE CAMERA CONTROLS

GENERAL: The EIA sync generator and video processing unit can be separated up to a maximum of 1000 feet from the camera.



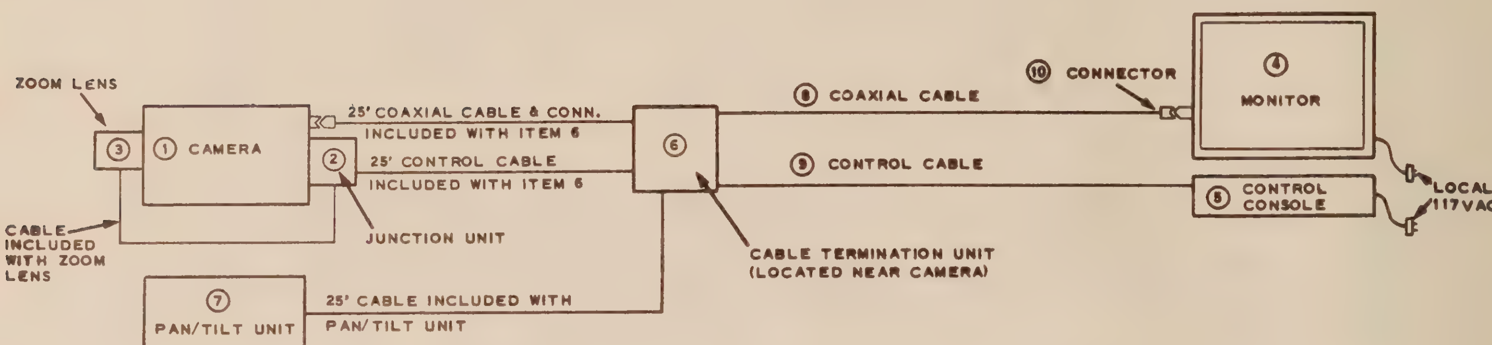
ORDERING INFORMATION

Item No.	Model No.	Equipment Description
1.	S1120C-VSP100 or S1122C-VSP100 or S1121C-VSP100	Indoor EIA Sync Camera with separate video processing unit (includes camera controls). All-Weather EIA Sync Camera with separate video processing unit (includes camera controls). Dust-Tight and Explosionproof EIA Sync Camera with separate video processing unit (includes camera controls).
2.	SLN6156A	Junction Unit
3.	SLN614?A	Lens, (?)-Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	VSP-603	EIA Sync Generator, rack-mount
6.	SKN6111A and SKN6112A	RG59B/U Coaxial Cable (two cables required-specify length of cable) Double-Shielded Polyfoam Coaxial Cable (one cable required-specify length of cable)
7.	SKN6113A	9-Conductor Control Cable (specify length of cable)

SYSTEM PLANNERS

SYSTEM V - AREA SURVEILLANCE CONTROL SYSTEM

PURPOSE: This system enables remote control of:
a) Camera functions
b) Zoom lens
c) Pan/Tilt movement and speed
Electric power for the camera, pan/tilt unit and zoom lens is provided via the control cable.



ORDERING INFORMATION

Item No.	Model No.	Equipment Description
1.	S1120C or S1121C or S1122C	Indoor Random Interlace Camera Dust-Tight and Explosionproof Random Interlace Camera All-Weather Random Interlace Camera
2.	SLN6156A	Junction Unit
3.	VSP-020-2401	Zoom Lens, f/2.0, 0.7" to 2.8" (add VSP-020-2402 Range Extender to increase range to: 1.2" to 5.0", at f/2.8)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	S1138A	Area Surveillance Control Console (add SLN6137A Rack-Mount Adapter for rack-mounting)
6.	SLN6139A	Weatherproof Cable Termination Unit
7.	VSP-020-42 or VSP-020-41 or VSP-020-40	Indoor Camera Pan and Tilt Unit Dust-Tight and Explosionproof Camera Pan and Tilt Accessory Unit All-Weather Camera Pan and Tilt Unit
8.	SKN6112A	Double-Shielded Polyfoam Coaxial Cable (specify length of cable in feet.
9.	SKN6115A	23 Conductor Control Cable (specify length of cable in feet)
10.	SLN6155A	Male UHF Connectors (consists of two connectors)

SYSTEM PLANNERS

MOTOROLA CLOSED CIRCUIT TELEVISION EQUIPMENT
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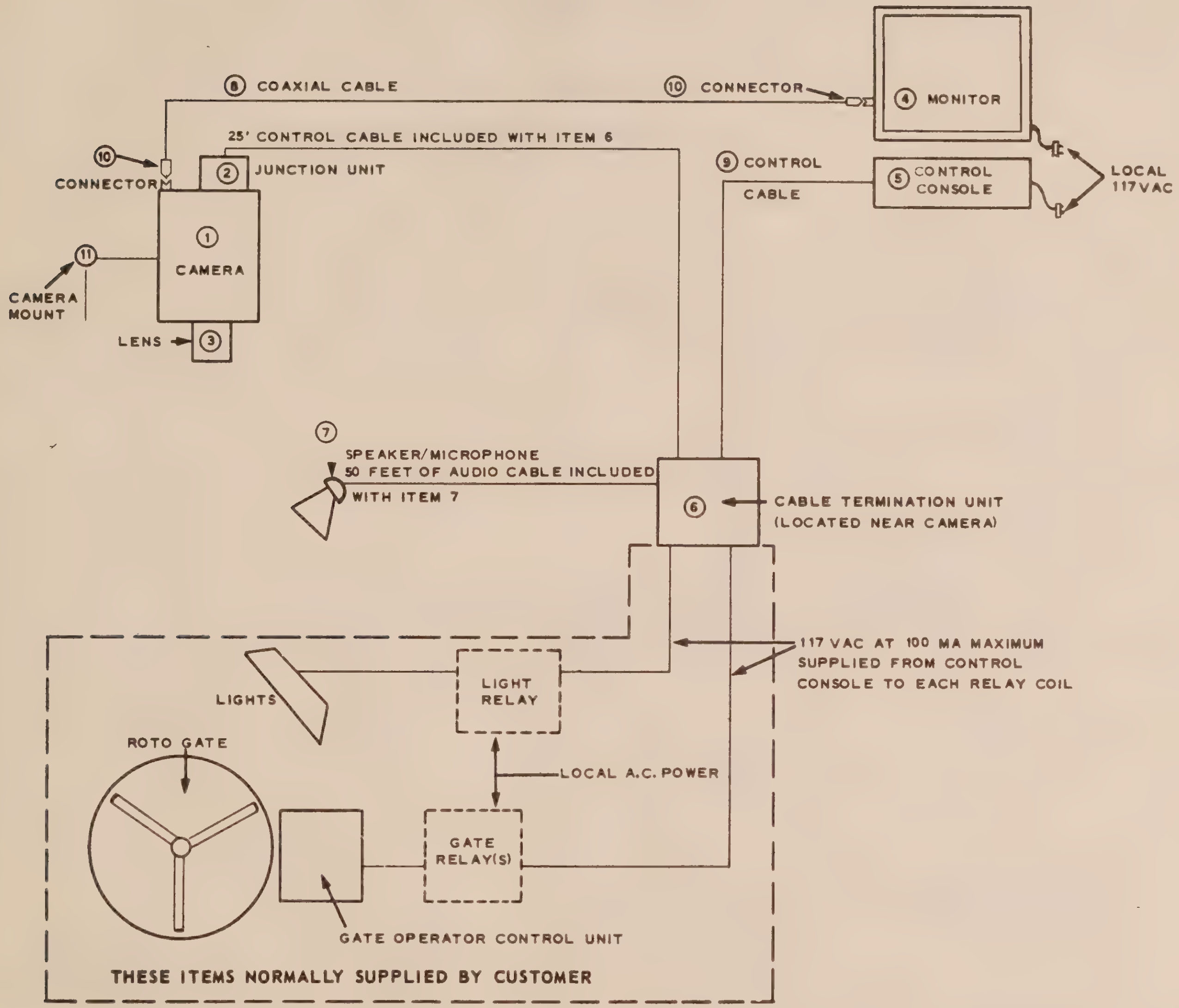
Replaces
Page 7 Issue 1 Date 2-22-65

SYSTEM VI - GATE WATCH CONTROL SYSTEMS

A. Remote Operation of Personnel Gate



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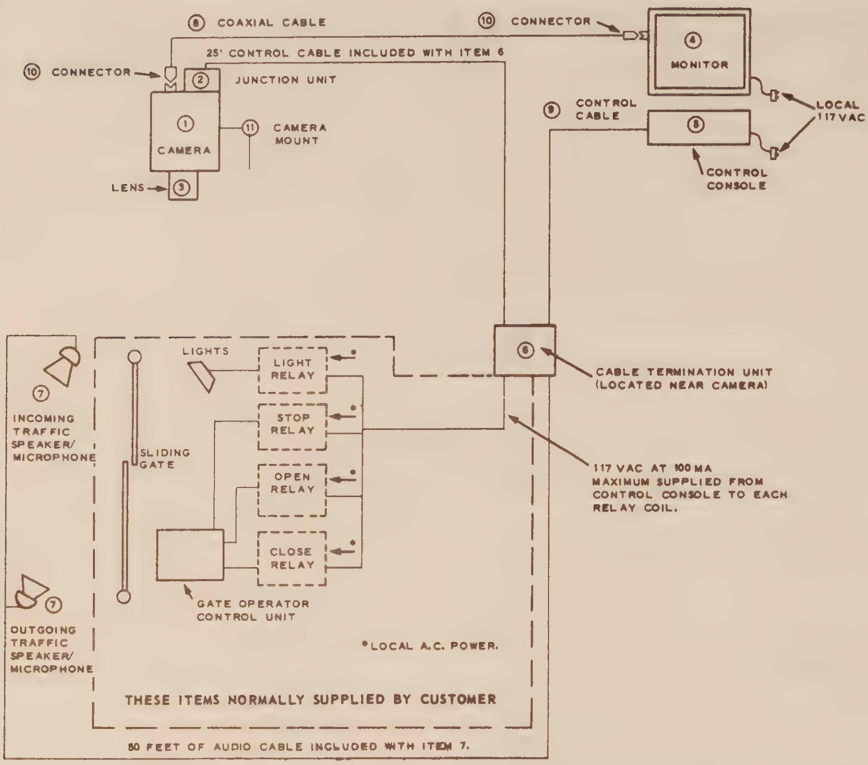
SYSTEM PLANNERS

SYSTEM VI - GATE WATCH CONTROL SYSTEMS (continued)

B. Remote Operation of Vehicle Gate



ORDERING INFORMATION FOR SYSTEM A or B

Item No.	Model No.	Equipment Description
1.	S1120C or S1121C or S1122C	Indoor Random Interlace Camera Dust-Tight and Explosionproof Random Interlace Camera All-Weather Random Interlace Camera
2.	SLN6156A	Junction Unit
3.	SLN614?A	Lens, (?)-Inch (fixed)
4.	S1101C or S1102C	14" Cabinet Monitor 14" Rack-Mount Monitor
5.	S1139A	Gate Watch Control Console (add SLN6137A Rack-Mount Adapter for rack mounting).
6.	SLN6139A	Weatherproof Cable Termination Unit.
7.	SLN6138A	Weatherproof Speaker/Microphone (order two for vehicle gate).
8.	SKN6112A	Double-Shielded Polyfoam Coaxial Cable (specify length of cable in feet)
9.	SKN6114A	16 Conductor Control Cable (specify length of cable in feet)
10.	SLN6155A	Male UHF Connectors (consists of two connectors)
11.	VSP-020-95	Indoor Camera Mount (indoor camera only)

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CA2-VI-E
TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA2

PART VI – SECTION E
INSTALLATION TECHNIQUES

Aside from the electrical details of installation, many mechanical details must be taken under consideration. The following information is presented as an aid to simplify the original installation and, possibly more important, the routine maintenance to follow.

The location of the camera is of prime importance. The area to be viewed, existing facilities, or customer desires may restrict the general use of camera placement. Care should be taken to avoid placing the camera near heating ducts, steam, or hot water pipe, or any place where temperature extremes may be encountered. For best results, the camera should be installed where vibration, shock, dust, and humidity are at a minimum. Though designed for industrial use, it should be remembered that the camera is a complex electronic instrument and should be treated as such.

For portable operation the camera may be mounted on a camera tripod. A tripod will provide easy adjustments when quick changes are desired.

Fixed camera locations demand a sturdy, vibration free mount. This is of particular importance when employing a long focal length lens. A 1/32" jitter or bounce at the camera can result in more than 1/2" bounce on the 14" monitor presentation.

The monitor may be placed in any convenient location, but care should be taken to avoid glare on the face of the picture tube from overhead lighting. For comfortable viewing of a 14" monitor, a distance of from 3-to-15 feet should be maintained between monitor and viewer.

For service and maintenance convenience it is desirable to place all equipment at readily accessible locations. Ideal locations would allow on the site servicing of camera and monitor.

The Motorola weatherproof camera housing has provisions for the use of locks to secure the housing cover. Use of locks will discourage tampering with camera by unqualified personnel.

Interconnecting cable in an installation may be installed in several ways. This cable, both video (coaxial) and control, when used in overhead distribution is suspended between poles. The cable is not strong enough to support its own weight, so a steel cable, called a messenger, is used as a support and the system cable is lashed to it. This lashing distributes the weight of the cable among many supporting points. Cable suspended by a messenger is less difficult to maintain than buried cable.

If the cable must be buried, it should be surrounded by a layer of sand or encased in conduit. This helps to prevent accidental piercing of the cable jacket during and after burial.

Armored cable is a necessity for buried cable installations when conduit is not used. Vermin and insects will chew through a cable jacket of polyvinyl chloride or polyethylene.

A foamed dielectric coaxial cable is recommended for underground installations where conduit is used. Conduit shields the cable from vermin and provides a mechanically strong casing.

If at all possible buried cable should be one continuous length. When the cable must be spliced all connecting fittings must be waterproofed.

Minnesota Mining and Manufacturing Company makes a splicing kit which may be used for this purpose. It completely encases the connection in a plastic resin mold. The brand name is "Scotchcast Splicing Kit".

A less expensive method of waterproofing is to use a special silicone tape and shrinkable plastic tubing. Type 602 Mox tape is wrapped around the splice and Thermofit tubing manufactured by Rayclad, Inc. is slipped over the wrapped connection. When heat is supplied, the tubing shrinks and gives a waterproof seal.

At many installations a ground potential difference exists between the camera and the monitor. This is evidenced by the appearance of hum bars on the monitor presentation. "Floating" one end of the system will eliminate the hum bars. The use of an isolation transformer is suggested as a safety measure.

At the time of installation, all pertinent information should be noted by the installing serviceman. Noting the color coding of the control cable for instance, will make original installation checks and future servicing much easier.

Neatness and accuracy can not be over-emphasized. Appearance and ease of maintenance are dependent primarily on these two factors.

Customer satisfaction being of paramount importance, a good looking installation, requiring a minimum of service "down-time" should be the prime aim of the installation and maintenance technician.

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VI – SECTION F
BASIC SYSTEM TROUBLESHOOTING

An understanding of the THEORY OF OPERATION and MAINTENANCE AND ADJUSTMENTS of all units of a system is essential for efficient troubleshooting. Adjustment and repair of the individual system components should be undertaken only by a qualified serviceman. The following information is presented as an aid to localizing defective units.

The first step in system troubleshooting is to determine which of the major units is at fault. In the simplest system, this may be the camera and its associated controls, the monitor, or the video cable.

In any case of malfunction all fuses, power sources and system intercabling and terminations should be checked.

"Open" or "shorted" conditions of the video cable may be determined by the use of a dc resistance meter.

The use of a calibrated time base oscilloscope at the output of a properly terminated camera will quickly show whether the camera is functioning correctly. Provided the output video wave form is normal and the video cable is known to be good, the malfunction is, by elimination, in the monitor.

In the event the camera output wave form is not normal, the defective unit is, of course, the camera. The assumption is made that all control settings have been properly adjusted.

It is important to note that in a camera which has been operating properly, a defect that may occur is seldom, if ever, corrected by the indescriminate adjusting of secondary controls. The primary controls (beam, target, electrical focus) may at times be adjusted to compensate for varying conditions, but the internal controls are optimized during factory testing and, sometimes, during installation to compensate for long cable runs, lighting, etc. Once properly set, these secondary controls normally do not require further adjustment.

With systems employing one camera and two or more monitors, any faults appearing on one or more, but not all, monitors indicate a monitor or cable defect. If all monitors in the chain exhibit the defect, the malfunction originates in the camera or possibly in the interconnecting cable.

Systems using two or more cameras and one or more monitors employ video switching equipment. Using the previously stated reasoning the defective unit may be located by a process of elimination.

Accessory unit defects tend to isolate themselves. That is, the failure of a pan and tilt unit to pan or tilt, would not be a camera or monitor failure. Similarly, the failure of a zoom lens to focus must be a defect of the lens, its cabling or power supply.

Original installation troubles are most commonly caused by incorrect wiring, improper terminations and misadjusted controls. Careful step by step check-out of the system as a whole will usually remedy this type of trouble.

Once the trouble has been localized to a piece of equipment, the troubleshooting procedure for that piece of equipment should be followed.

MOTOROLA
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CA2-VI-G
TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VI. SECTION G
TEST EQUIPMENT AND COMPONENTS STOCK

Motorola's CCTV equipment can be serviced with a minimum of test equipment and components. However, the test equipment and components should be in accordance with the following lists and the procedures outlined in the Motorola instruction manuals should be followed.

The following list of test equipment is considered the minimum requirement for a well equipped service station:

Oscilloscope	Motorola T1014B
Electronic Voltmeter	Motorola S1063A
Variable Transformer with Meter	Motorola 25A82568G02

In addition to the listed test equipment the service station should have a signal source, preferably a Motorola camera, to be used for monitor servicing, and a monitor to be used for camera servicing.

Since the cost of a camera to be used as a signal source may be considered prohibitive, an alternate signal source can be provided by using a high quality conventional television receiver. The television receiver can be modified by inserting a small unbypassed resistor (usually about 100 ohms) between the cathode of the video output stage and ground. This modification in a receiver in which the cathode of the picture tube is driven will provide about 2 volts peak-to-peak composite video for insertion in an unterminated monitor input. Do not use a "hot chassis" type television receiver for this application. The connecting cable to the monitor, since it is unterminated, should not be more than 10 feet long.

An additional requirement for camera servicing is a well illuminated test pattern. The pattern supplied in the Motorola instruction manual is satisfactory for routine maintenance work but should not be used for exact measurements of camera performance.

One piece of equipment not included in the above list is a dot or cross hatch generator. This piece of equipment, although desirable for the alignment of television equipment, is not required for ordinary servicing. Horizontal linearity of the Motorola camera is not adjustable and will be well within the specified tolerance if the pulse amplitudes and shapes are as specified. Vertical linearity of the Motorola camera is adjustable but can be set by observing the vertical deflection yoke voltage wave form and adjusting it to be linear using the oscilloscope. Once the camera is determined to be linear it can then be used with a test pattern to set the linearity of the monitor. Therefore, a dot or cross hatch generator is not required for routine servicing or maintenance of the television equipment but is required only for very exact alignment for special applications.

The required stock of replacement parts for Motorola closed circuit television equipment depends on several factors. These factors include the application, the environmental conditions, the geographic location, etc. For many installations, permissable down-time will be the determining factor.

No components in Motorola's line of CCTV equipment, with the exception of vacuum tubes, are "weak links". All components are conservatively rated and designed for operation over an extensive environmental range. No components, other than Vacuum tubes, have a limited or predictable life expectancy.

The point of this discussion is:

> There is no predictable advantage in stocking any of the components, with the exception of vacuum tubes, for Motorola's line of CCTV equipment unless every component is stocked (except as affected by simple probability; ex., if 50% of the components

are stocked, the probability that a required replacement component will be available is 50%).

Vacuum tube life is known to be limited. This limitation is extended significantly when using Motorola's "Golden M" tubes in the extremely conservative circuit designs used in Motorola's equipment. The failure rate of tubes in Motorola CCTV equipment is so low that a stock of one tube of each type should suffice for in excess of one year. This stock should suffice even if the equipment is in continuous operation, and one tube of each type should be enough for one, two or three pieces of a given type of equipment.

Monitor picture tube life expectancy is essentially the same as for other vacuum tubes. However, the size and weight of picture tubes may make stocking undesirable.

Vidicon tubes for Motorola cameras also have a limited life expectancy. This life in many installations has been in excess of two to three years. Vidicons are, however, subject to sunburning in outdoor installation, and consequently their useful life can be reduced considerably. Vidicon sunburning will not occur in a properly installed and operated system.

It is recommended that vidicon tubes should not be stocked unless there is a definite need to keep downtime at an absolute minimum. Vidicon tubes, compared to other CCTV components, are relatively expensive, have a shorter warranty period and may in some cases degrade while on the shelf.

Motorola replacement parts are available through depots in the continental United States. With air shipment, these parts are available within two days to almost any location. In an emergency, many of the parts can be obtained from local parts distributors although the use of genuine Motorola parts is recommended. (This recommendation definitely includes the use of Motorola vacuum tubes).

Many models in the Motorola line are composed of modular sub-assemblies. These sub-assemblies are tested and pre-aligned. In those cases where a modular sub-assembly is found to be defective, it will be convenient to replace the entire assembly. Sub-assemblies are available through Motorola parts depots.

IN SUMMATION - Although the decision concerning stocking of replacement parts depends on many factors, it is suggested that in most cases only a small stock of vacuum tubes should be considered.

MOTOROLA

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CA2-VI-H

TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION

COURSE No. CA 2

PART VI – SECTION H
THE WOBBULATOR

THE "WOBBULATOR"

FOR ALIGNING THE VIDICON BEAM FOR BEST RESOLUTION

The best possible resolution of a CCTV system can be obtained quite readily by the use of a low-cost piece of test equipment called a "Wobbulator" to adjust the Vidicon beam. This technique is fast and more accurate than "by eye".

Proper Vidicon beam alignment is essential to obtain best resolution. This requires that the beam be not only centered on the target, but that it strikes the target perpendicularly.

The use of the Wobbulator and a schematic with detailed parts list are covered below.

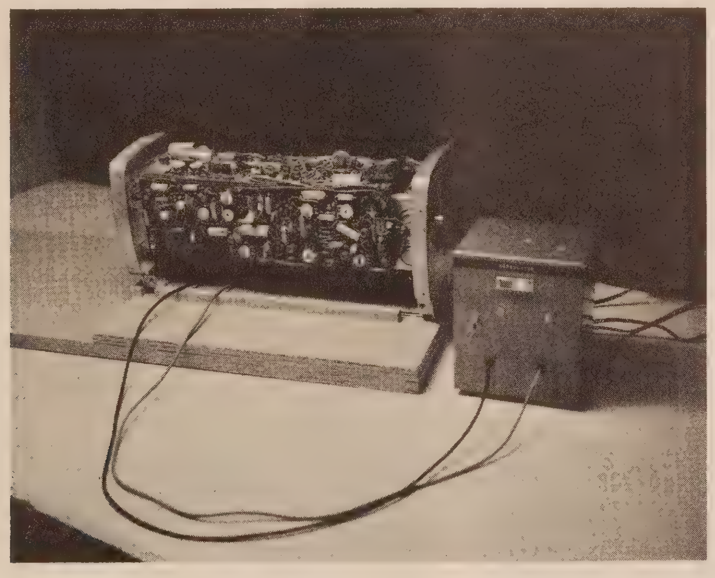


Figure 1
Wobbulator Connected To Camera

CAMERA BEAM ALIGNMENT PROCEDURE

1. Assuming a properly adjusted Monitor is being used, mount the test pattern on a wall and set the Camera with the axis of the lens in line with the center of the test pattern and perpendicular to it.

2. Adjust the Horizontal Size and Vertical Size controls on the Camera for maximum scan (control is turned fully clockwise).

3. Adjust the camera housing so that the test pattern falls in the center of the vidicon faceplate as viewed on the monitor.

4. Check for proper distance from lens mounting plate to test pattern as prescribed in the following chart:

TEST PATTERN TO LENS DISTANCE

PATTERN WIDTH	LENS FOCAL LENGTH	
	1"	2"
9"	17.0"	34.0"
12"	22.7"	45.4"
24"	45.4"	90.8"

5. Readjust the Horizontal and Vertical Size controls of the Camera for proper scan. The pattern arrowheads should be at the edges of the monitor scanned area.

6. Attach the Wobbulator output lead to Camera grid #3 (pin 6) and the ground lead to the chassis, and turn on. There are no adjustments on the Wobbulator.

7. Loosen the hold-down screws on the Beam Magnets so they can be rotated for adjustment.

8. Adjust the Beam Magnets for super position of the center circles and equal rotation of the diagonals as shown in Figure 3.

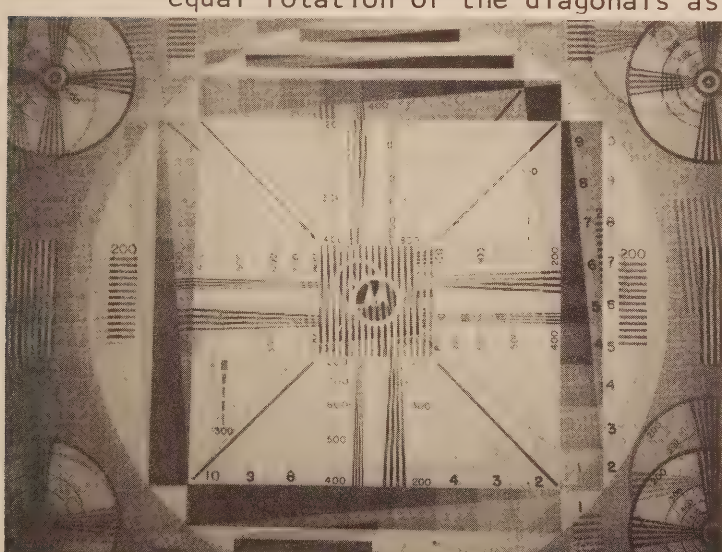


Figure 2
Incorrect Beam Adjustment (Unequal Rotation of Diagonals and Center Circles not Superimposed.)

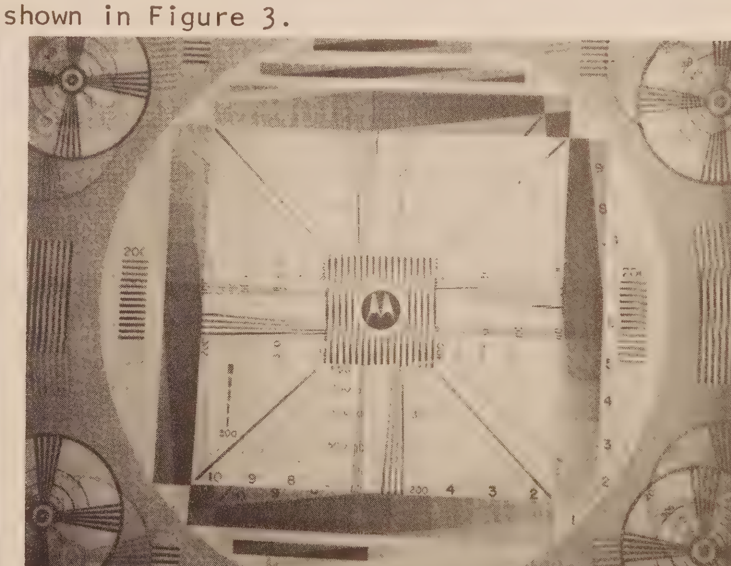


Figure 3
Correct Beam Adjustment (Equal Rotation of Diagonals Super Position of Center Circle.)

9. Fasten the Beam Magnets in position by tightening the holding screws. Be careful not to allow the magnets to slip out of position.

10. Readjust horizontal and vertical centering as required, and if necessary, adjust picture tilt.

11. If proper beam alignment cannot be obtained, it may be necessary to rotate the Vidicon and socket so the short pin on the Vidicon is moved from the 3 o'clock position, 180° to the 9 o'clock position. This should be necessary only on Vidicons having had many hours of use, and the beam path from the filament may have shifted beyond control of the Beam Magnets.

SCHEMATIC DIAGRAM

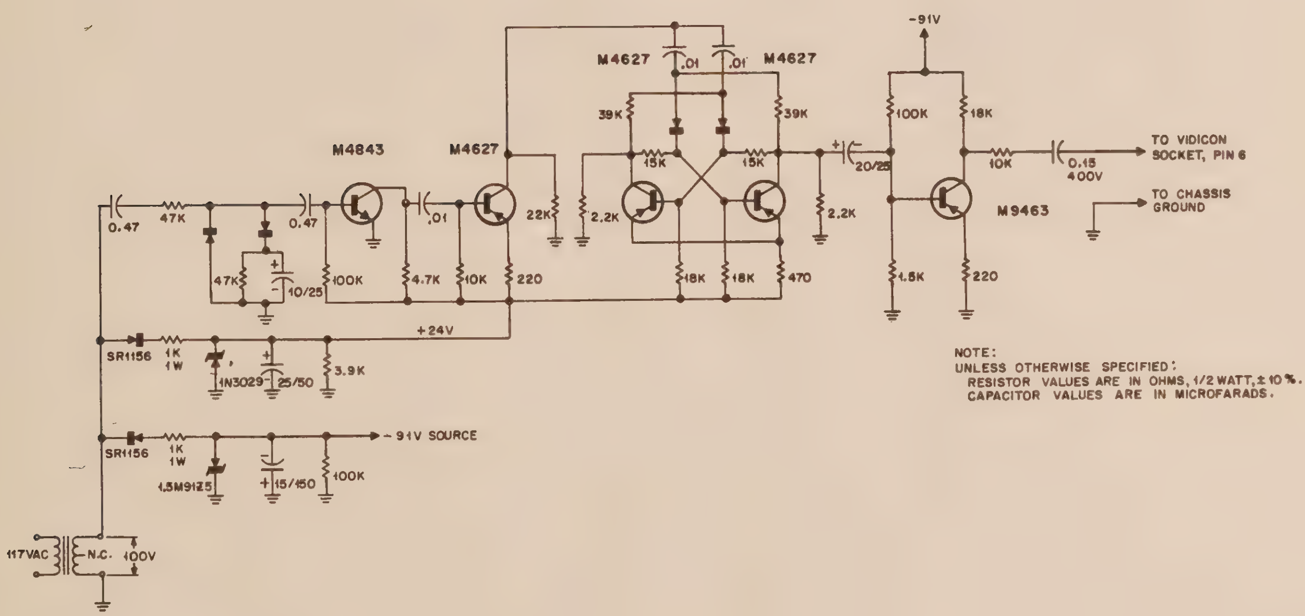


Figure 4

WOBBULATOR CIRCUIT

A "Divide-By-Two" Bistable Oscillator with 90V P.P. 30 Hz Square Wave Output

NOTE

The four unmarked diodes in this circuit are 1N3029 A's.

The switch and neon pilot light are not shown. Connect pilot and limiting resistor across transformer primary.

PARTS LIST FOR WOBBULATOR
(For the Testing of CCTV Cameras)

Qty.	Description	Motorola Part No.
1	100V Transformer	25C82468G01
2	SR1156 Diode	48C82466H17
1	1.5M91Z5 or 1N3812 Zener Diode	48P83042H29
1	1N3029B Zener Diode	48P83624E80
4	1N3029A Diode	48 82533D03

Resistors

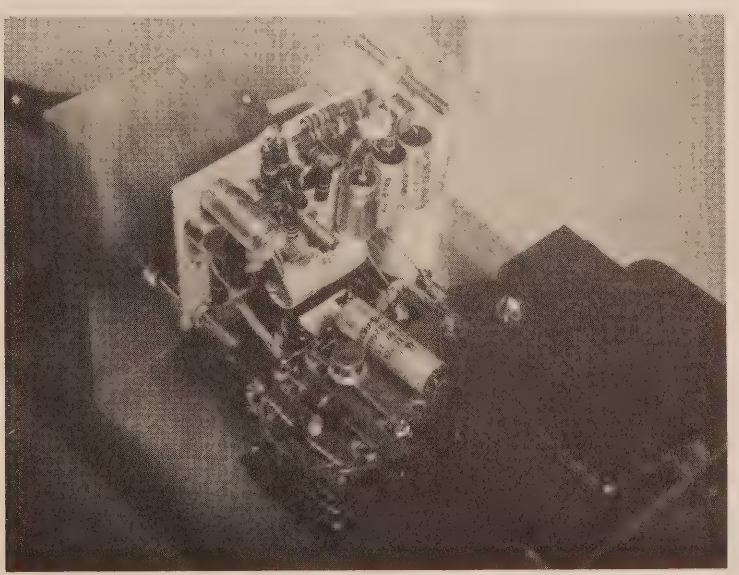
Qty.	Value (ohms)	Power (watts)	Tolerance (per cent)	Motorola Part No.
2	220	1/2	10	6R6270
1	470	1/2	10	6R6090
2	1K	1	10	6R6327
1	1.5K	1/2	10	6R6038
2	2.2K	1/2	10	6R6069
1	3.9K	1/2	10	6R5659
1	4.7K	1/2	10	6R6080
2	10K	1/2	10	6R6320
2	15K	1/2	10	6R6477
3	18K	1/2	10	6R5591
1	22K	1/2	10	6R6397
2	39K	1/2	10	6R6487
2	47K	1/2	10	6R6048
3	100K	1/2	10	6R6031

Capacitors

Qty.	Value (mfd)	Voltage (volts)	Motorola Part No.
3	.01	200	8K857473
1	.15	400	8K877098
2	.47	200	8K863028
1	10	25	23D82783B27
1	15	150	23D82601A17
1	20	25	23D82601A03
1	25	50	23K850516

-continued-

Qty.	Description	Motorola Part No.
	Transistors	
3	M4627	48R134627
1	M4843	48R134843
1	M9463	48R869463
	Miscellaneous	
1	SPST Toggle Switch	40A482097
1	Neon Pilot Lamp	65K898920
1	Pilot Light Assembly w/Clear Jewel	60A824821
1	Pilot Lamp Current Limiting Resistor	6R129226
2	Test Leads w/Alligator Clips	
1	Line Cord	30K857576
2	Rubber Grommets for Test Leads	
1	Rubber Grommet for Line Cord	
4	Rubber Feet	
1	6x5x4 Mini Box	



TOTAL USER COST:

Motorola Parts	$48.58
Mini-Box	1.75
TOTAL	$50.33

Figure 5
Typical Parts Layout

MOTOROLA

COMMUNICATION and ELECTRONICS, INC.

CA2-VI-1

TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VI — SECTION I
INSTRUCTION MANUALS

The instruction manuals in this section describe only a small part of the Motorola line of Closed Circuit Television equipment. A thorough understanding of these few manuals should, however, equip the maintenance technician with enough information to allow him to service the majority of CCTV equipment. Most of the other equipment used in CCTV systems is mechanical, optical or similar to electronic equipment presently being serviced by the maintenance technician.

Instruction manuals are shipped with all Motorola CCTV equipment. When a special or unique system wiring diagram is required, it too is shipped with the equipment.

NOTE: The following manuals are bound into this book:

68P81048A90 — MODEL S1140A TRANSISTORIZED CAMERA
68P81039A25 — MODEL S1219A TRANSISTORIZED MONITOR
68P81054A70 — MODEL S1239A GATE WATCH CONTROL CONSOLE
68P81054A65 — MODEL S1238A AREA SURVEILLANCE CONTROL CONSOLE

An additional manual which may be used with this course is:

68P81036A10 — MODEL S1120C TRANSISTORIZED CAMERA

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CA2-VI-J
TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION

COURSE No. CA 2

PART VI – SECTION J
PAN AND TILT MAINTENANCE PROCEDURES

The procedure outlined below should be followed to correct backlash in both pan and tilt gear trains. The following instructions apply to either pan or tilt motor.

Remove the housing cover and loosen the four mounting screws of the motor plate. Slide the entire motor assembly away from its drive gear. Retighten motor screws. The backlash in the pan or tilt mechanism is corrected by repositioning of the adjustable ball located on the end of the worm gear opposite the motor side. This is accomplished by loosening the 6-32 allenhead setscrew holding the ball idler screw. Loosen this ball idler screw and then retighten noting any sideward movement of the worm gear. This sideward motion would be parallel with the motor axis.

If sideward movement is observed, loosen the 1/4-20 nut on the bolt screwed into the threaded hole in boss of motor plate. This bolt is located in line with the worm gear axis and slightly off center. Rotate bolt. If motion of worm was in a direction toward the center of unit, rotate bolt clockwise as viewed from head end. Tighten ball idler and ball idler setscrew. With a combination of tightening and loosening these two adjustments, motor can be aligned with ball idler so as to eliminate thrust movement of gears, the major cause of gear wear.

After above adjustments are complete, loosen the four motor mounting plate screws slightly. With a small hammer and flat-end punch, gently tap motor plate back into position until gear mesh is achieved.

If unit has been in operation using only a small portion of the maximum possible rotation, wear on this section of the bronze drive gears may have occurred. If so, re-mesh gears on high spot of gear. Check adjustment by electrically rotating unit and rocking of housing and tilt mounting table completely through entire rotation that unit will be operated at. If excessive wear of bronze gears is noted, replace gears. (CAUTION: When re-meshing tilt gears, be sure that tilt gearhead is resting securely on head of thrust bolt of housing. Do not apply excessive force due to large forces applied to gears through lever action.)

Constantly check for backlash by:

a. Pan – Holding mounting base, rock housing back and forth until little or no backlash is observed.

b. Tilt – Same as above, except rock tilt table.

Units that are used in the autoscan mode continuously (24 hours-a-day operation) should have a backlash check every two weeks. If the units are run at approximately half speed the check should be made once a month.

Refer to instruction manual for lubrication instructions.

CLOSED CIRCUIT TELEVISION...

COURSE No. CA 2

PART VII. CLOSED CIRCUT TELEVISION APPLICATIONS

Closed circuit television is a tool with applications limited only by the ingenuity of the user. Its widespread usage in Business, Industry, Public Safety and Military systems attest to its overwhelming acceptance.

For this reason this section has been included to point out some of the benefits provided by closed circuit television and some of the uses to which it has been put.

In looking through the "case histories" you will note outstanding savings in manpower requirements and dollar outlays. More efficient control -- the universal benefit in every instance -- can best be achieved when a system is operating at its best. For this reason, qualified maintenance is a prime requisite for any installation.

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CA2-VIII

TECHNICAL TRAINING DEPARTMENT

CLOSED CIRCUIT TELEVISION...

COURSE No. CA

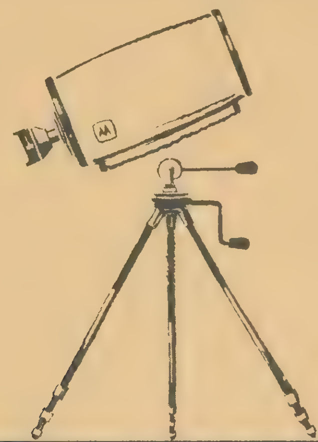
PART VIII – ADDITIONAL REFERENCE MATERIAL

NOTE: The following catalog sheets are included for reference:

E-444	800 Line Resolution Indoor Camera
E-445	800 Line Resolution Dust-Tight and Explosion-Proof Camera
E-446	800 Line Resolution All-Weather Camera
E-447	Camera Mounting Accessories
E-481	Remote Control Pan-And-Tilt Units
E-485	Lenses for Closed-Circuit Television Cameras
E-487	Remote Control Consoles for Gate Watch and Area Surveillance Systems
E-489	800 Line Resolution, Compact 27" Video Monitor
E-814	Solid-State 9-Inch Video Monitor
E-815	800 Line Resolution S/40 Camera
E-816	Environmental Camera Housings
E-817	Industrial and Institutional Video Training and Documentation Systems
E-818	Industrial and Institutional Video Training and Documentation Systems
E-819	Industrial and Institutional Video Training and Documentation Systems
TIC 3040	SKN6111A RG59 B/U Coax Cable
TIC 3041	SKN6112A Coax Cable
TIC 3042	SKN6113A Control Cable
TIC 3043	SKN6114A Control Cable
TIC 3044	SKN6115A Control Cable

CCTV

MOTOROLA *closed circuit television · transistorized cameras and control kits*

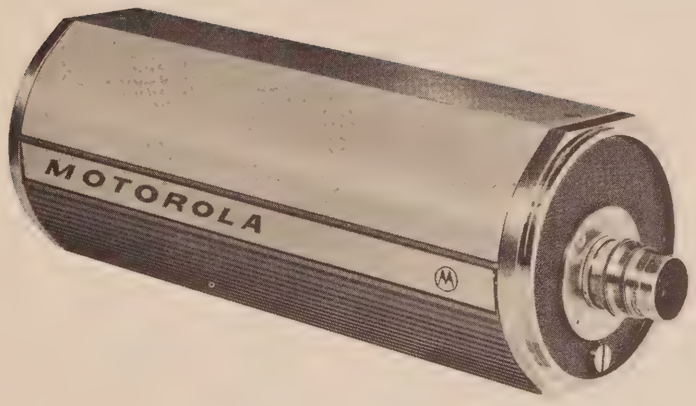


MOTOROLA INC., COMMUNICATIONS DIVISION · INSTRUCTION MANUAL 68P81048A90-A

MOTOROLA

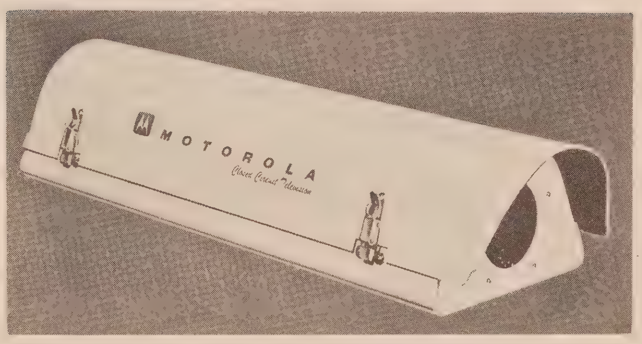
CLOSED CIRCUIT TELEVISION

TRANSISTORIZED CAMERA AND CONTROL KIT



Model S1140A
Camera

Model SDN6117A
Explosion-Proof Housing



Model SHN6112A
All-Weather Housing

MOTOROLA INC. Communications Division

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

3/1/68-UP

68P81048A90
Issue - A

FOREWORD

This manual offers complete information on the operation, theory and servicing of the transistorized television cameras described in it.

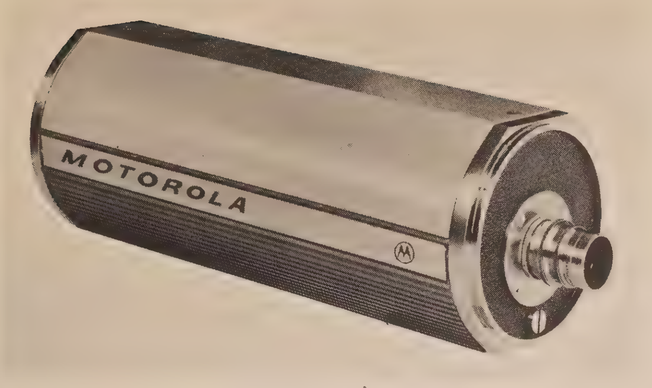
Television system requirements are outlined to provide a broad basis for understanding the operation of a television camera.

This manual was prepared for use by the inexperienced as well as the experienced serviceman. The inexperienced serviceman can use the step-by-step troubleshooting chart which provides quick isolation of a possible malfunction to a circuit board; then replace the board in just a few minutes time. A detailed circuit description enables the experienced serviceman to gain the thorough knowledge of camera circuitry needed to repair any circuit with the aid of a two-color schematic bearing voltage and waveform information. Location of components can be efficiently accomplished by referring to each full size circuit board photo.

CONTENTS

SECTION | PAGE

TRANSISTORIZED CAMERAS



Model S1140A

CAMERA MODEL TABLE

MODEL	DESCRIPTION
S1140A	Indoor Camera
SDN6117A	Explosion-Proof Camera Housing
SHN6112A	All-Weather, Dust-Tight Camera Housing

CAMERA MODEL COMPLEMENT TABLE

COMPLEMENT	
KIT	DESCRIPTION
SLN6166A	Video Amplifier Kit
SLN6167A	Power Supply and Deflection Kit
SHN6120A	Housing and Chassis Kit

1. DESCRIPTION

a. General

The Motorola Transistorized Television Camera is a rugged, high resolution, random interlace camera that is particularly suited to industrial applications where excellent performance, compact design, stability of operation and low power consumption are desirable. The CAMERA MODEL TABLE lists camera models which include housings for specific applications. Each camera model contains a series of kits shown in the CAMERA MODEL COMPLEMENT TABLE.

The Model S1140A Indoor Camera is for general industrial use where environmental conditions are suitable for efficient camera operation. Model SHN6112A is an all-weather, dust-tight camera housing for outdoor or dusty applications. If a camera is to be operated in areas where explosive materials or atmospheres are present, use the Model SDN6117A Explosion-Proof Camera Housing. All circuits of this camera are adequately shielded to prevent ignition of explosive atmospheres.

The CAMERA MODEL COMPLEMENT TABLE illustrates the modular design of the Motorola camera. Modular design provides many desirable service features:

(1) Each module can be removed and replaced in a few minutes, when necessary.

(2) Servicing and adjustments are readily performed because all components are on the exposed side of the module board.

(3) Chassis mounted components such as the vidicon tube, power transformer, etc. are also accessible.

The Motorola camera, a local or remote control unit and a Motorola monitor are the only units of equipment necessary for a random interlace, closed circuit television system of exceptional quality.

The Motorola Transistorized Television Camera contains an automatic light compensation circuit. This circuitry compensates for a 4000 to 1 variation in light levels of the televised scene. This feature eliminates the need to make camera sensitivity adjustments for normal light variations. A manual control is also provided should it become necessary to operate the camera under extreme lighting conditions. The operator can select between automatic or manual control of camera sensitivity.

Each closed circuit television system using a Motorola camera can be brought to optimum performance by controls within the camera. These controls compensate for normal losses in long cable runs and eliminate the need for line amplifiers for cable runs up to 2000 feet.

Loss of definition, due to the finite size of the vidicon scanning spot, is brought under control by special circuitry which overcomes this limitation.

The camera vidicon tube is protected from damage, if the horizontal or vertical sweep circuits fail, by automatic circuits which disable the vidicon target voltage and accelerating potential.

b. Camera Control Units

Motorola Transistorized Television Cameras can be operated locally, or from any remote location. For local operation, a control kit is attached to the rear of the camera. For remote operation, the camera is connected to the remote control

facilities by a junction box attached to the rear of the camera and a control cable. Both desk and rack mounted remote camera control units are available.

Control facilities include the following:

(1) POWER, ON-OFF

Applies 117 v ac to the camera.

(2) FOCUS

Adjusts the vidicon electrical focus.

(3) BEAM

Adjusts vidicon beam current.

(4) TARGET, MANual-AUTOmatic

(a) Remote Camera Control Units

A single control selects the level of vidicon sensitivity TARGET adjustment. The operator rotates the knob to adjust vidicon sensitivity to compensate for extreme lighting conditions. This is the MANual mode of sensitivity adjustment. For the AUTOmatic mode, the potentiometer is disabled and camera circuits automatically perform the vidicon sensitivity adjustment.

(b) Local Camera Control Unit

Two controls select the mode and level of vidicon target voltage (sensitivity) adjustment. One is a part of the two-position, rotary switch for either MANual or AUTOmatic target voltage adjustment. When placed in the MANual position, a second control, the TARGET potentiometer, is added to the camera circuitry. The potentiometer is used to adjust vidicon target voltage to compensate for extreme lighting conditions. When the switch is placed in the AUTOmatic position, the potentiometer is disabled and camera circuits automatically perform the vidicon target voltage adjustment.

c. Accessories

(1) SCN6127A Local Control Kit

This kit provides control of the BEAM, TARGET and FOCUS camera functions. It plugs on to the back of the S1140A Camera and should be used when desirable to power and control the camera at the signal origination point.

(2) SLN6172A Junction Unit

This junction unit is available for use when the camera is connected to a remote power source and control panel.

2. INSTALLATION

a. Camera Housing Installation

(1) Model S1140A Indoor Camera

Remove the protective plug covering the vidicon face at the front of the camera. Attach capped lens to the camera. Store the protective plug for future use, in the event the camera is moved or shipped without the capped lens attached to the camera. The protective plug performs the same function as the lens cap, in that it shields the vidicon face from intense light sources which could damage the vidicon photoconductive layer.

(2) Model SDN6117A Explosion-Proof Camera Housing

Carefully remove the camera chassis from packing and install a control kit. Refer to the CAMERA CONTROL KITS section of this manual for installation and cabling information.

With the rear plate of the housing removed as shown in figure 1, perform the following steps.

(a) Loosen camera sled by turning the sled lock-rod counterclockwise.

(b) Slide camera sled and lock-rod out of housing.

(c) Attach camera to camera sled as shown in figure 1.

(d) Remove the protective plug covering the vidicon face at the front of the camera. Attach capped lens to the camera. Store the protective plug for future use, should the camera be moved or shipped without the capped lens and lens mount attached. It performs the same function as the lens cap, in that it shields the vidicon face from intense light sources which could damage the vidicon photoconductive layer.

(e) Uncap lens and return camera sled, with attached camera and lock-rod, to the sled track within the housing. Slide camera into housing

so that the lens is 1/4" from inside surface of housing window.

CAUTION

Care should be exercised to avoid jamming camera lens against housing window.

(f) Lock the camera chassis in place by turning the lock-rod clockwise. Then push the lock-rod completely into housing.

(g) Replace rear plate on housing. Tighten all bolts gradually, in sequence, so that uniform pressure is applied to rear plate.

(3) Model SHN6112A All-Weather Camera Housing

Carefully remove camera from packing and install Model SLN6172A Junction Box Kit. Model SCN6127A Local Camera Control Kit can be installed for special applications. Refer to the CAMERA CONTROL KITS section of this manual for installation and cabling information.

Remove the top section of the all-weather housing by opening the four housing cover fasteners, and lift the cover from the housing. Perform the following steps.

(a) Remove the camera mounting plate that is secured to the inside of the housing by removing two brackets as shown in figure 2A.

(b) Attach the camera mounting plate to the camera as shown in figure 2B.

(c) Remove the protective plug covering the vidicon face at the front of the camera. Attach capped lens to the camera. Store the protective plug for future use, should the camera be moved or shipped without the capped lens and lens mount attached. It performs the same function as the lens cap, in that it shields the vidicon face from intense light sources which could damage the vidicon photoconductive layer.

(d) Replace camera mounting plate with attached camera in bottom of housing and secure in position with brackets shown in figure 2A so that the uncapped lens is 1/4" from inside surface of housing window.

CAUTION

Care should be exercised to avoid jamming camera lens against housing window.

(e) Replace housing cover and lock in place with attached fasteners.

b. Mounting and Location

For portable operation, where the camera will be moved from one location to another, the most convenient type of mount will probably be a camera tripod. A tripod will provide easy adjustment when quick changes are required. This may be necessary for such operations as factory time study or meter monitoring.

For fixed scene observations, such as line operations, guard or security service, etc., it is desirable that the camera be mounted on a fixed mount where it cannot easily be disturbed.

For best results, the camera should be installed where there is a minimum amount of vibration, shock, dust, humidity and temperature extremes. If any one of these conditions prevail to an unusual extent, proper steps should be taken during the installation to protect the camera. Although designed for industrial use, it should be remembered that it is a complex electronic instrument and should be treated with consideration.

c. Lenses

Motorola lenses with focal lengths varying from 1/2-inch to 6-inches are available. The focal length of a lens may be utilized to obtain a particular field of view or to change image size. Using the 1-inch lens, as a reference, the magnification and field of view of the other lenses can be compared to it. Therefore, changing to a 2-inch lens will magnify the scene so that objects are approximately twice as large or give the appearance of having moved the camera in to 1/2 the distance. The field of view for the 2-inch lens is only about half that of the 1-inch lens.

It is not possible to go into all the factors involved in the choice of lenses, because other considerations such as aperture, perspective, depth of field, etc. will influence lens choice. If the user is unfamiliar with the optical problems involved, the answer may be found experimentally or by consulting your Motorola representative.

d. Lighting

The importance of proper lighting on the scene cannot be over emphasized. Improper arrangement or type of lighting, even though the light level is more than sufficient, may actually reduce the presentation of the scene.

The first factor of importance that should be remembered is that the lighted scene as it appears

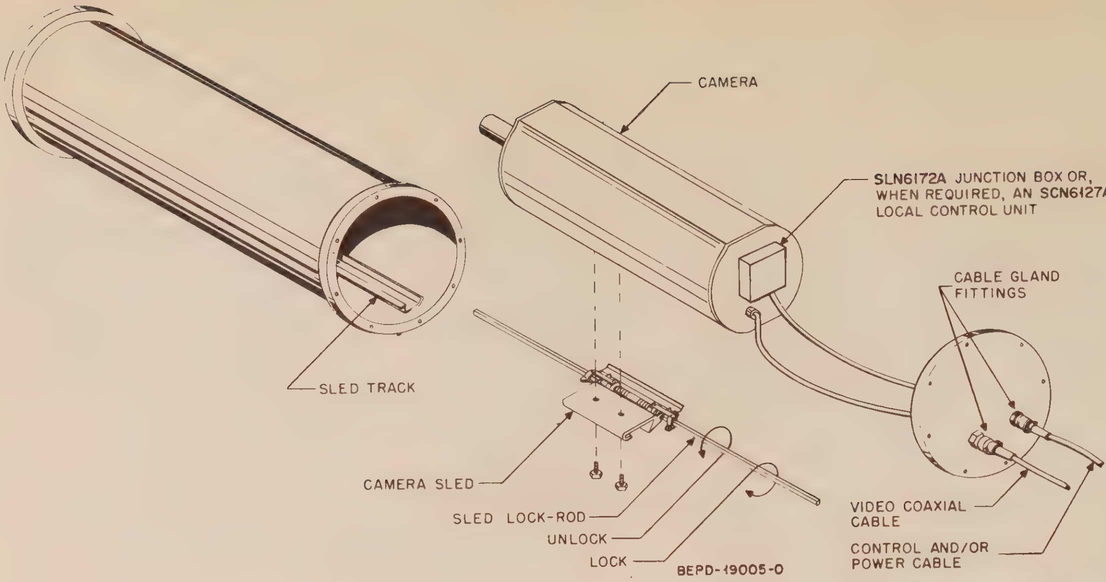


Figure 1. Explosion-Proof Camera Installation

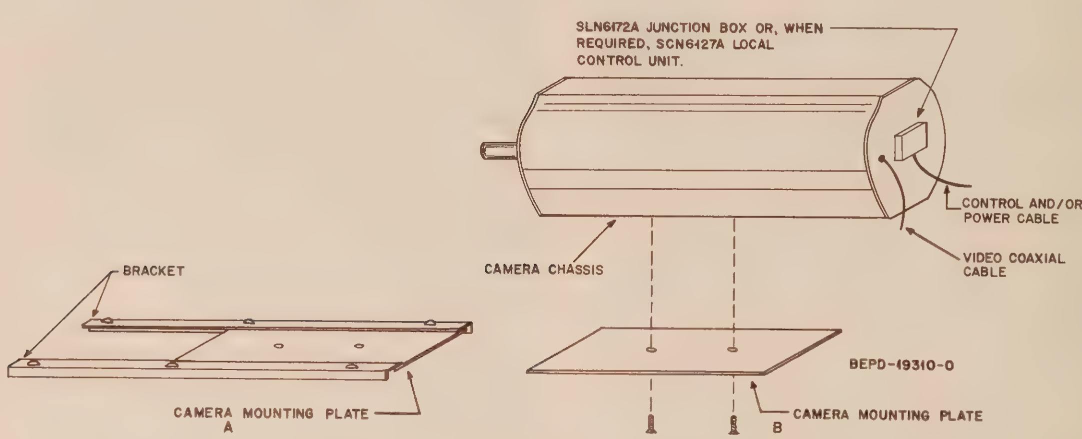


Figure 2. All-Weather Camera Installation

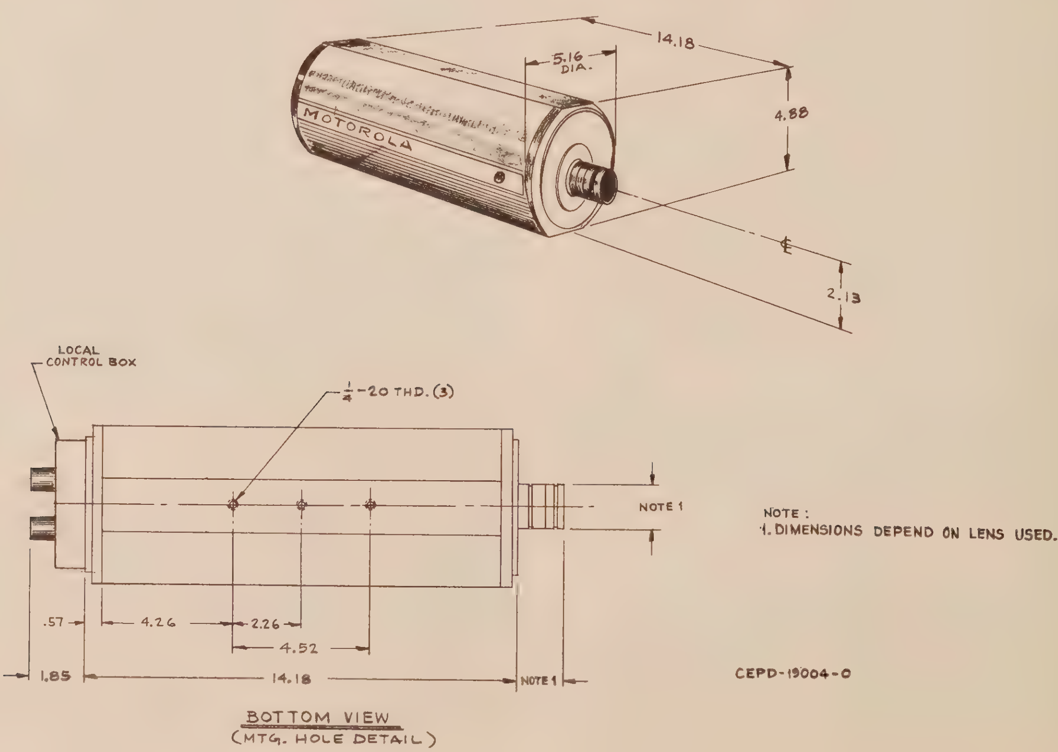


Figure 3. Camera Mounting Detail

to the eye, may be a poor indication of the scene as it is finally resolved through the TV system. The eye automatically makes many compensations which a camera is not able to do. Some hints which will help in obtaining proper lighting are:

(1) Locate light sources above or at sides of the camera.

(2) Keep scene uniformly illuminated and avoid extreme contrasts.

(3) Maintain at least 50 foot candles of light at all points. This should be measured with the light meter positioned at the scene and pointed directly toward the camera lens.

(4) Avoid deep pockets or darkly shaded areas.

(5) Avoid highlight reflections from mirror surfaces.

(6) Never point camera directly toward the sun. Damage to the vidicon may result.

(7) Try both fluorescent and incandescent lighting. One type of lighting may be better than another depending upon subject matter. In general, the flat diffused characteristic of fluorescent lighting produces good results.

(8) If a choice is available, the background should not be brighter than the main object in the scene to be viewed. A dull, pastel background should be used: white or glossy backgrounds avoided. Avoid pointing the camera into a dark room with daylight streaming through windows facing the camera.

(9) Daylight may be used as an auxiliary to indoor lighting by keeping the windows behind or to one side of the camera.

(10) When flames, light bulbs or other self luminescent objects are to be included in the scene, the extreme contrast produced by such objects can be lessened by use of filters in front of the offending object, or if this is not possible use a light background to reduce contrast.

Finally, it may be impossible in your particular application to use the preferred techniques given above. Under these circumstances, a proper understanding of the operation of your equipment is necessary for best results.

e. Electrical Connections

For local control of camera functions, attach Local Camera Control Kit, Model SCN6127A to the back of the camera with hardware provided. If the closed circuit television system requires remote control of camera functions, install remote control facilities according to instructions supplied with the equipment.

The camera, to operate properly must be terminated in a 72-75 ohm resistive load. This termination should be made at the end of the transmission cable connecting the camera to the viewing monitor.

To connect the camera to the viewing monitor, use the cable and connector type shown in the following table. The cable may be run in any convenient fashion between the camera and monitor.

Type of Coaxial Cable Used	Connector Type	Connector Kit No.*
SKN6111A	Male UHF	SLN6154A
SKN6112A	Male UHF	SLN6155A

*Kits include one connector for each end of cable.

SKN6111A Cable can be used without accessory amplifiers, for transmission over distances up to 500 feet. For distances up to 1000 feet, SKN6112A Polyfoam Cable can be used without accessory amplifiers. In areas of severe electrical interference, SKN6112A should be used for best results. In all cases, when installing the cable, care should be exercised to keep it away from power transformers or other sources of electrical interference.

CAUTION

Keep the cable away from steam pipes and other locations where the temperature might be considerably above normal room temperature.

It should be remembered that when more than one monitor is used, the total load on the camera should not differ from 75 ohms, nominally.

3. OPERATING INSTRUCTIONS

a. Operating Controls

Cameras are shipped from the factory with the best overall setting of all internal controls. It is suggested that no internal control adjustments be made unless it is determined that, for the particular application, the performance is inadequate (see ADJUSTMENTS & MAINTENANCE for initial settings).

NOTE

The lens should be adjusted for optimum optical focus BEFORE any electrical adjustments are made.

Controls which must be adjusted for the televised scene are described in this section. These controls are referred to as operating controls. They are easily accessible without removing the camera housing cover. If desired, they may be removed to permit operation of the camera from any remote location.

(1) OFF-MANual-AUTOmatic

This is a three position switch which when placed in the MAN or AUTO position applies 117 v ac to the camera power transformer. In the AUTO position, voltage applied to the vidicon target is adjusted by the amount of light entering the camera. When extreme variations in lighting conditions exist, as in pan and tilt operation over a large area with extreme variation in light level, the selector is placed in the MAN position. When in the MAN position, the (TARGET) control can be rotated to adjust target voltage to the proper level according to the following paragraph.

(2) Manual Sensitivity TARGET Adjustment

Manual sensitivity TARGET adjustment is used when lighting conditions are beyond the capabilities of the automatic circuitry. The minimum target voltage necessary to resolve a satisfactory picture should be used. An increase in target voltage (clockwise rotation) increases the sensitivity of the vidicon, but also increases the image retention time of the photoconductive surface. If excessive target voltage is used, the image retention time can exceed the time required to sweep one frame and an object that has moved will be seen in its new position and also, less intense, in its former position. A moving object will exhibit a diffused trailing edge. This phenomenon is referred to as "stickiness" of the picture. Also, excessive target voltage can cause the image to be permanently impressed on the photoconductive layer. This is known as image "burn-in". Therefore, best results are obtained by illuminating the scene with as much light as possible and setting the target control for minimum operating voltage.

NOTE

No picture will be seen if the manual adjustment of sensitivity TARGET is set too low.

(3) BEAM

The BEAM control determines the amount of beam current by adjusting the vidicon control grid. More beam current is required to resolve the bright areas in the image than is required to resolve the dark areas. The BEAM control, therefore, affects the light handling ability of the vidicon. It is more critical in setting than the target control. The control should be set at the point where all picture highlights are just resolved. A further increase in beam current reduces picture resolution and may result in spurious shading of the picture.

NOTE

No picture will be seen if the BEAM control is set too low.

(4) FOCUS

The electrical FOCUS control adjusts the current in the focus coil around the vidicon. It operates with the fixed electrostatic field developed by the focus electrode to focus the vidicon scanning beam on the photoconductive target. It is adjusted for best overall resolution of the televised scene.

b. Obtaining a Picture

(1) Train camera on scene to be observed and set the BEAM control to the maximum counterclockwise position.

(2) Turn camera and monitor ON and allow several minutes warm-up time.

(3) Place the power switch in the AUTO position.

(4) Advance the BEAM control from maximum counterclockwise position to the point where a picture is seen.

(5) Adjust FOCUS control for best overall picture resolution.

(6) Adjust lens collar for sharpest focus on the principal object to be monitored.

(7) Decrease the lens iris opening (larger f/number) to provide sufficient depth of field. The greater the depth of field, the less optical focus adjustment is required at the camera for "travel" or "follow" shots. The iris opening may be decreased as far as the prevailing light level and desired picture contrast will allow. If stopped down too far, the picture display will suffer from video noise.

(8) Retard and then advance the BEAM control until all picture highlights are just resolved.

(9) Adjust the camera FOCUS control for best overall resolution of the televised scene.

(10) Repeat steps (8) and (9) for optimum adjustment.

(11) For best monitor presentation, proceed as follows:

(a) Turn monitor CONTRAST control maximum counterclockwise.

(b) Adjust monitor BRIGHTNESS control until raster is just visible under prevailing ambient light.

(c) Rotate CONTRAST control clockwise for desired contrast in picture. Slight readjustment of BRIGHTNESS may be necessary for desired picture.

(12) If signal from camera appears weak (poor contrast), check for improper lens stop adjustment or insufficient light on scene.

(13) If highlights are not resolved on the monitor (no detail in light portions with blooming whites), stop lens down. If this condition still persists, adjust the camera BEAM control until highlights are just resolved.

(14) Should the preceding adjustment fail to provide a satisfactory picture because of unusual or insufficient scene illumination, place the AUTOmatic-MANual control in the MAN position. Make the following adjustments.

(a) Open the lens iris to the lowest f/stop number.

(b) Place the BEAM control in the middle of its range.

(c) Advance the TARGET control until a picture is seen.

(d) Adjust the BEAM control until highlights are just resolved.

(e) Adjust camera FOCUS control for maximum picture resolution.

NOTE

When using the MANual sensitivity adjustment, best resolution is achieved by keeping both TARGET and BEAM settings as low as possible.

4. GENERAL CIRCUIT DESCRIPTION

a. Introduction

In a closed circuit television system, picture information is transmitted to the video monitor by a coaxial cable. In the Motorola system, this picture information is in the form of a composite video signal. Basically, the composite video signal has a video component and a sync component. The video component gives the monitor the scene information as the camera sees it, and the sync component directs the monitor in the presentation of this information. The quality of the monitor presentation is therefore dependent on the quality of the composite video signal.

The quality of the video component is a function of video signal bandwidth. The greater the bandwidth, the greater the horizontal resolution capabilities of a television system. The Motorola camera provides sufficient bandwidth for a minimum of 800 lines of horizontal resolution.

The sync component consists of vertical and horizontal blanking pulses and may also include vertical and horizontal sync pulses. These pulses keep the video monitor sweep circuits synchronized with camera scanning and blanking. Since these pulses control the sequence of monitor presentation, their timing, pulse shape and pulse duration must be maintained by providing adequate signal bandpass in camera circuits.

The cable used in the transmission of closed circuit video signals is specifically designed for this application. However, it is impossible to eliminate all video losses in the cable. The losses which are attributed to the cable, generally manifest themselves as high frequency attenuation (a loss in horizontal resolution) and video frequency phase shift. The degree of phase shift and amount of high frequency attenuation is proportional to the length of transmission cable.

During the processing of the video signal in the video amplifier an attempt is made to correct for the losses about to be incurred in the transmission cable. This correction is not universal, for the amount of correction necessary is dependent on the type of cable used and its length. The adjustments provided in the video amplifier can be used to optimize a particular system. In these cases where the transmission distances are very long, line amplifiers will have to be used to preserve the resolution capabilities of the camera. The number of line amplifiers required will depend on the length and type of the transmission cable.

b. Video Amplifier

The circuitry referred to herein as a video amplifier is functionally more than just a video amplifier, for it is here that the signal from the vidicon is amplified, shaped and processed to the extent that a usable composite video signal is made available at the output jack.

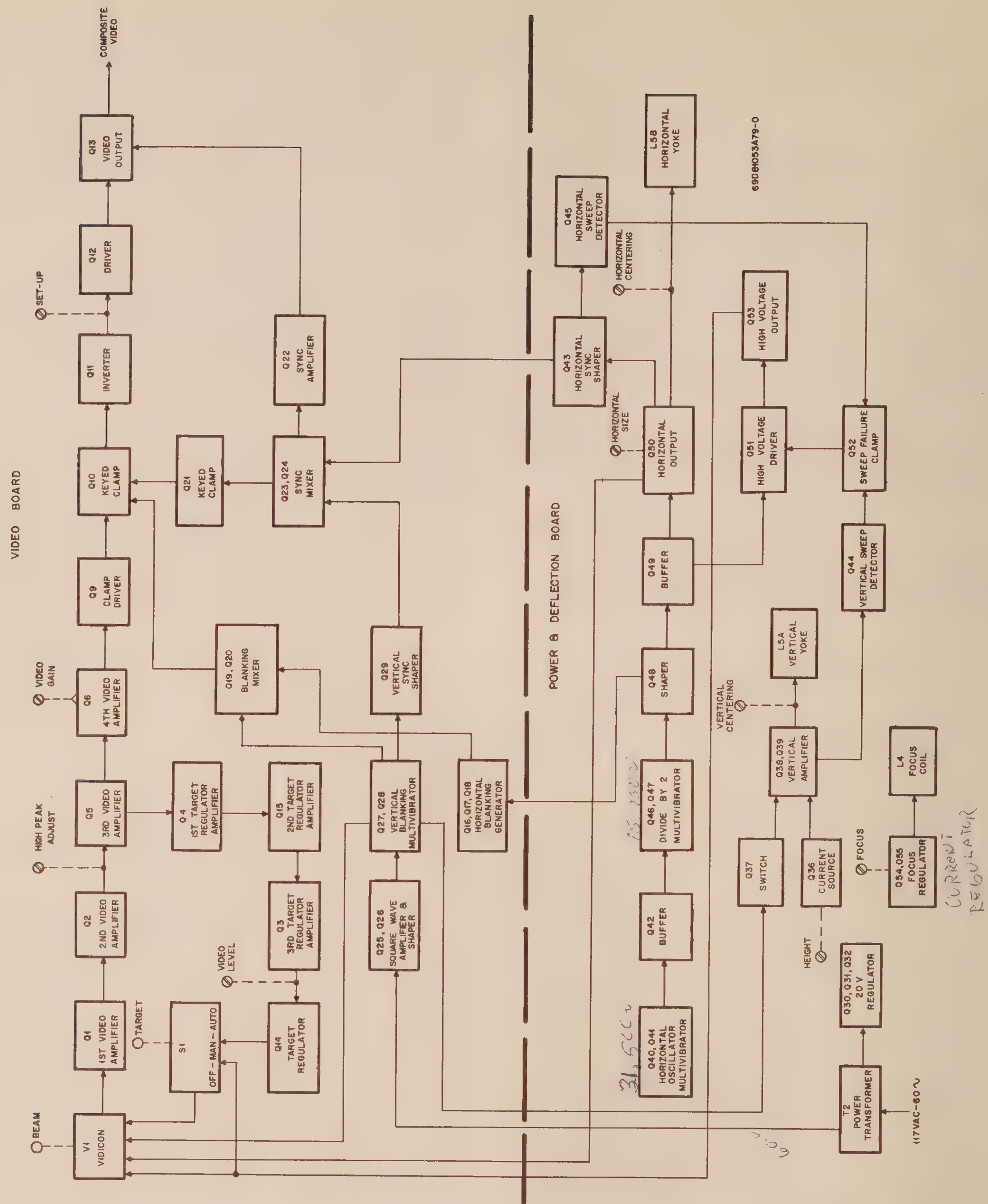


Figure 4.
Transistorized Camera Block Diagram

The processing and shaping consists of high frequency emphasis and aperture correction. Processing includes horizontal and vertical blanking insertion, and horizontal and vertical sync insertion. Controls for adjusting these critical functions are provided, thus enabling the video presentation to be optimized for the particular system and conditions which are present.

Because of amplifier high frequency losses and decreasing vidicon output at high frequencies, emphasis must be given these frequencies. If the frequency output of the amplifier were flat, the high frequency losses in the transmission cable would impair the video signal before it reached the monitor input. The high frequency emphasis therefore compensates for the amplifier and cable losses as well as the decreasing vidicon output. Compensation for losses of high frequencies results in the high frequency portion of the video spectrum having a greater amplitude than the low frequency portion (at the video amplifier output jack). The signal amplitude is thus seen to rise as the frequency goes up; the amplitude being proportional to the losses which will be incurred. The object, of course, is to have a frequency input to the monitor which is essentially flat.

High frequency emphasis can be achieved either by having the amplifier gain increase for the higher frequencies, or by attenuating the lower frequencies. Both of these methods are used in the camera video amplifier. Controlled amounts of high frequency gain and low frequency attenuation are used to obtain a frequency response curve of the desired shape. The first, second, third, fourth and seventh stages, labelled "AMPLIFIER" in the block diagram, are used for high frequency compensation.

Three stages in the video amplifier are simple current amplifiers, the primary function of which is impedance matching between stages. Two of these are labelled "Buffer" in the block diagram and the other is the "Output Driver". They do not process the video signal; however, they do amplify it.

Aperture correction is distributed throughout the video amplifier. Aperture correction is used to increase the picture definition which was lost because the scanning spot in the vidicon is not infinitely small. The loss in definition occurs in the following manner. The electron scanning beam within the vidicon has a finite spot size. As the beam moves over the picture, the beam spot covers a finite picture area and a video signal is developed the amplitude of which is proportional to the amount of light received from the picture. Consider the case where the spot scans across a sharp change from white to black. When the spot is in the white portion of the scene, the amplitude of the video signal corresponds to the scene white. As the spot moves into the black, because of its finite size, it does not change completely from white to black but goes through an interim period where a portion of the spot is in the white and the other portion of it is in the black. The vidicon beam goes through an averaging process and the video signal assumes an amplitude which is proportional to the average of the light received by the spot. When the vidicon beam spot is centered over the white-black boundary, half the spot will be white and half of it will be black. The average light received by the beam spot will cause the video signal to have an amplitude somewhere between black and white. The result then will be that as the spot moves from the white to black region, the video signal will go from white, through all the scales of gray, and finally become black. The monitor presentation will follow this signal and go from white, through grays, to black and will not show a definite transition from white to black. This results in the video presentation suffering a loss in definition.

The vidicon beam spot size is determined by certain physical and operating characteristics of the vidicon. With all vidicon circuits optimized, the spot will be of a minimum finite size. To further increase the definition, the compensation must be performed on the video signal, and this is the function of the aperture correction circuitry.

The sixth, seventh, eighth and ninth stages combine the video, blanking, and sync signals in the correct proportions and amplitudes to satisfy the requirements of the television monitor. The gain control stage has a control for adjusting the peak-to-peak voltage of the video signal. After the video signal has passed through the gain control stage and the keyed clamp the horizontal and vertical blanking pulses are added to it. The signal, which is now a composite video signal, is then coupled to the inverter stage.

The inverter, in addition to amplification, inverts the signal so that it is of the proper polarity for the black-level control circuitry. Moreover, together with the keyed clamp circuit, the inverter maintains a constant predetermined level for the blacks in the video signal.

The average brightness of each line will vary, depending on what portion of the image is being scanned; therefore, the average potential of the video signal will be determined by the average brightness of the image in the scanned lines. The

result is that the black-level which is represented by a certain potential in one scanned line, may be represented by a different potential in another scanned line. The key clamp maintains this black-level at a constant potential regardless of the average brightness of the line.

At the beginning of each scan line, the keyed clamp circuit is triggered by a horizontal sync pulse. It then clamps the input of the inverter to a fixed reference potential. When the horizontal pulse is removed the keyed clamp releases the inverter input, which allows the interter to follow the amplitude variations of the video signal. In this manner, the signal black will be maintained at the same potential for all scan lines.

The eighth stage, which is the set-up control stage, determines the potential difference between the bottom of the blanking pulses and the video blacks. This is the same as determining how much of the composite signal is to be occupied by the video signal.

The last two stages of the video amplifier are the output driver and video output stages. They provide signal amplification and impedance matching for a 75 ohm output.

c. Vertical Circuitry

The vertical circuitry of the camera provides the vertical sawtooth signal for the vidicon sweep, blanking pulses for insertion into the video signal and for vidicon retrace blanking, and the vertical sync pulses for insertion into the video signal. The power line frequency establishes the vertical sweep rate. The 60 cycle per second sine wave from the power line is coupled to the pulse shaper and amplifier with the resulting output being a waveform suitable for generating the vertical waveforms.

Vertical blanking pulses are generated by the vertical blanking multivibrator. These pulses are coupled to the vidicon to cut it off during the verti-retrace interval. The vertical blanking pulses are also coupled to the vertical blanking mixer where they are amplified, combined with the horizontal blanking pulses, and then added to the video signal. In addition, these blanking pulses are coupled to the vertical sync former which generates the vertical sync pulses. These are then coupled to the sync mixer together with the horizontal sync pulses and added to the horizontal and vertical blanking pulses.

The vertical sweep sawtooth signal, used for vidicon deflection, is generated from the sync stage. After two stages of amplification the sweep signal is coupled to the vertical deflection yoke and the vertical sweep failure protection circuitry. The vertical sweep failure protection circuitry disables the high voltage driver if it fails to receive a vertical sweep signal. With the high voltage driver disabled, the vidicon potentials are no longer generated and the vidicon target area is protected from having a horizontal or vertical line burned into it.

d. Horizontal Circuitry

The horizontal circuitry of the camera provides the horizontal sawtooth signal of the vidicon sweep, high voltage for the accelerating and focusing grids of the vidicon, and an adjustable voltage for the vidicon target.

A crystal-controlled oscillator provides pulses which pass to a buffer stage, frequency divider, an amplifier stage, and are applied to an inductor. The inductor discharges through the horizontal deflecting yoke, after each pulse, to provide the linearly increasing sawtooth current.

The horizontal pulses are also applied to a transformer, then to a rectifier network to produce the regulated high voltage for the vidicon accelerating and focusing grids and the target. When target voltage is manually adjusted, the voltage is controlled by a potentiometer on the camera control unit. When automatic target (sensitivity) voltage adjustment is desired, the switch on the camera control unit is placed in the AUTOmatic position. A signal amplifier transistor amplifies a portion of the video signal and applies it to a rectifier circuit at the input of a target regulator transistor. As bias to the regulator transistor varies with the general level of the video signal (light level), voltage to the target varies. The target voltage is effectively controlled by the general lighting conditions of the televised scene.

5. DETAILED CIRCUIT DESCRIPTION

a. Vidicon

Of all the components required in an industrial closed circuit television camera, probably the most important is the vidicon tube. The illustration of the vidicon tube, figure 5, is highly exaggerated to illustrate operational functions. This sketch should be referred to during the vidicon discussion.

(1) Operational Functions

The light-sensitive element may be visualized as consisting of two separate elements

electrically: (a) a transparent conducting film coating on the inner surface of the glass faceplate, and (b) a thin layer of photoconductive material on the scanning side.

Four grids are used. Grid No. 1 is the control grid and has a picture cutoff value of -45 to -100 volts. Grid No. 2 is an accelerator grid usually operated at a fixed positive voltage in the vicinity of 350 volts. Grids 3 and 4 are focusing electrodes. The focusing grid potential, about 300 volts, creates an electrostatic field which, in conjunction with the uniform magnetic field from the external focusing coil, causes the electron scanning beam to focus at the photoconductive target (signal-electrode). The focusing voltage is fixed (constant electrostatic field), and the current through the external focusing coil is varied (variable magnetic field) to allow optimum electrical focus of the beam.

Grid No. 4 is actually a fine mesh screen adjacent to the photoconductive layer. This grid is connected to Grid No. 3 and is, therefore, at the same positive potential. Its purpose is to provide a uniform field on the beam side of the target. This causes the scanning beam to impinge perpendicularly on the photoconductive layer regardless of the angle from which it approaches. The target is maintained at a much lower positive potential (8-70 volts) and the arrangement may be seen to provide a "decelerating" action of the scanning beam. Hence, Grid No. 4 is often termed the decelerator grid.

The electron gun uses a 6.3-volt heater to heat a thermionic cathode, which may be placed at ground potential as shown in figure 5.

The metal ring around the front end of the tube is the signal lead connection, and the load resistor is connected to the electrode in series with the B+ supply. The complete circuit may then be seen to constitute ground, the scanning beam, the light sensitive surface, the load resistor R_L, and through the power supply to ground.

Under no light conditions, the photoconductive layer is essentiallv an insulator exhibiting a very high resistance. One plate of the electrically separated plates is charged to the positive potential of the signal electrode, while the other plate is floating. For the purpose of understanding the basic theory, we may think of the two plates as forming a capacitor with a di-electric resistance that is variable under conditions to be described. In the present analysis (no illumination reaching the target), the beam of negative electrons being swept across the target area under the influence of the scanning currents through the deflection yoke will be deposited upon the positive target surface until it is charged down to cathode potential. Thereafter, the remaining beam electrons are turned back under the influence of the positive grids to form a return beam. Although a considerable charge now exists across the opposite plates of the light sensitive element, the resistance is so high that very little current is passed. What little current does exist is termed the "dark current" on the tube.

Assume now that a light image is focused by the lens on the light sensitive element. The photoconductive film on the inner surface of the glass faceplate will now conduct slightly, an amount depending upon the intensity of the light at that particular point. The lowered resistance adjacent to this particular conducting element draws a few electrons from the plate on the gun side, causing it to rise slightly toward the positive potential of the target supply. In this way, a positive potential pattern in accordance with the light distribution in the focused image is caused to exist on the gun side of the target. Thus, more electrons are extracted from the total beam current to satisfy this deficiency of electrons on the traget This increased current in the signal path which includes R_L, causes a greater voltage drop through this resistor, which in turn causes the point where the coupling capacitor C_c, is connected, to swing in the negative direction. Since no light conditions result in minimum current and highlights cause maximum current, the signal to the amplifier is observed to swing in the negative direction for highlights in the scene, and positive for black portions.

(2) Signal Polarity

The polarity of a television signal is always given in terms of picture black, since blanking signal amplitude is always approximately near picture black and is held at a given reference level for any particular system. For this reason, the polarity of the signal at the output of the vidicon is said to be black positive, or simple positive polarity.

(3) Spectral Response

The spectral response of the vidicon is of interest in practical applications. The normal response of the human eye is from 4000-7000 Angstrom units. Violet (4000A region) is the shortest wavelength visible while red (7000A region) is the longest visible wavelength. The response of the vidicon

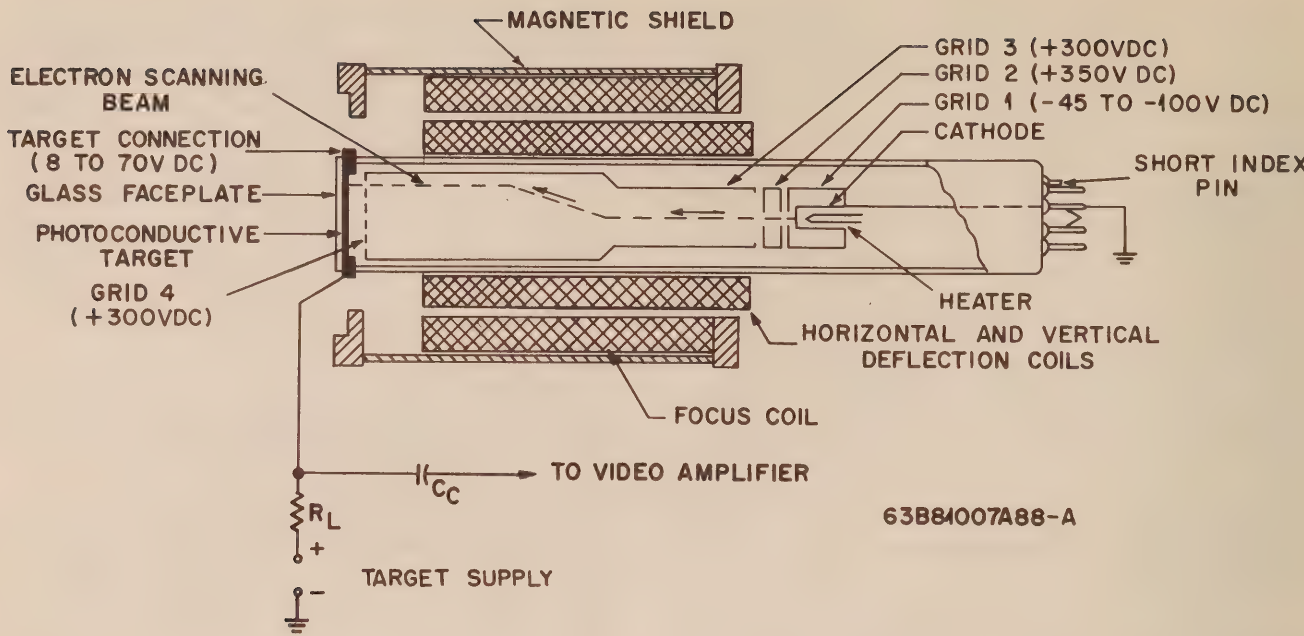


Figure 5.
Operation of Vidicon Tube

extends into both the ultra-violet and infra-red regions. It may be noted that while the maximum response range of the vidicon under daylight conditions is in the blue region of the color spectrum, the rising characteristic curve toward the red end of ordinary incandescent lighting brings the response curve over so that maximum sensitivity occurs in the green-yellow region, comparable to the human eye.

Lighting effects may be judged from these characteristics. If, for example, the objects to be viewed are fixed and have a color characteristic largely in the red region of the color spectrum incandescent lights will provide most efficient illumination in output current versus watts used. If, on the other hand, the objects contain largely blue or violet, or the color spectrum is well represented from violet to red, certain forms of fluorescent lighting will be most efficient. Combinations of incandescent and fluorescent lighting may be most advantageous when convenient to use.

(4) Persistence of Photoconductive Layer

Lighting conditions are also important in persistence characteristics of the vidicon when used to transmit moving objects. Persistence of the photoconductive layer is a measurement of the decay in signal-output current after illumination is cut off. The decay is measured from an initial signal-output current of 0.2 microamperes. In the vidicon, with adequate illumination on the photocathode, sudden removal of the light will cause the 0.2 microamperes to decay to 0.2 microamperes in 100 milliseconds. This decay rate is sufficient to reproduce all but the more rapidly moving objects without smearing. The persistence becomes greater, however, (longer decay time) at low levels of illumination which require relatively high target voltages. When this problem arises, the use of greater illumination will enable a further reduction in smearing by permitting the use of lower target voltages.

(5) Vidicon "Burn-In"

The vidicon photoconductive layer is deposited on a circular signal electrode. When used for TV work, the useful area is a quality rectangle of about 1/2-inch x 3/8-inch within this circular area. Scanning an area less than the quality area will generally result in reduced resolution. During the normal scan of the photo layer, a conditioning of the layer takes place which results in a change in sensitivity. Thus, normal use should produce a 1/2-inch x 3/8-inch rectangle within the total circle of the photoconductive layer which has a different sensitivity than the area surrounding this rectangle. This area is referred to as a normal raster "burn". It usually appears on a monitor screen as lighter rectangle surrounded by darker

edges. Increasing target (signal electrode) voltage will increase tendency, to excessive burn. If the full area is not used initially, a smaller raster "burn" will be produced. This is underscanning. If full size scanning is later produced, the underscanned area will be visible in the picture. It will, of course, be noticeable at the edges of the picture because the center of the normal and underscanned raster will overlap.

NOTE

This "normal" raster burn may not necessarily be present when tube is new.

During the testing and aging of the vidicon and the testing of the camera, the normal raster area will usually be "set" or "burned-in". If improper horizontal and/or vertical centering occurs so that a different area from the "set" area is used, the burn will be visible as a difference in picture brightness at one or more of the edges of the picture. Continued operation under these conditions will result in multiple raster burns. Consequently, every effort should be made when vidicon centering is shifted, or vidicon is removed from camera and subsequently replaced, to make certain that the same area is used as was previously scanned. In other words, adjust centering so that the new setting overlaps exactly on the old. This will also require that the vidicon be rotated to the same orientation on its longitudinal axis as previously.

(6) TARGET and BEAM Control Effects

Variation of target voltage, when manually adjusted, effects shading and contrast of the picture for a given amount of light on the scene. If low light level conditions are encountered, target voltage is raised to increase the sensitivity of the vidicon tube. Too high a target voltage will deteriorate picture quality, because of "dark current", as well as increase the tendency for image "burn-in".

The BEAM control adjusts the potential on the vidicon Grid No. 1. Decreasing this bias potential increases the vidicon beam current, which results in resolution of the highlight portion of the scene. Further bias reduction (increasing beam current) gradually resolves the brightest highlights. The observed action results from the fact that only a small amount of beam current is needed to resolve the darker portions, (less positive points of the target) but will not resolve the brighter (more positive) areas. As the beam current is increased, the picture "wipes clean" with the highlights appearing resolved last. The BEAM control is left just barely past the point of good highlight resolution, since a further increase causes excessive beam current that deteriorates the resoluation in the picture.

b. Video Amplification, Shaping and Processing

The video signal from the vidicon target receives several stages of amplification which raise the signal to the proper level for monitor application. In addition, the amplification stages are equalized using parallel inductances and series resistance-capacitance networks to provide high frequency emphasis and aperture correction which greatly improve picture quality. The video signal also receives sync and blanking information. The circuits which perform these operations are shown on the camera schematic diagram and described in the following paragraphs.

The vidicon signal is coupled by capacitor C1 to the base of common emitter stage Q1. It is amplified by transistor stages Q1 and Q2 and passed through a variable high peaking network consisting of capacitor C6 (HI PEAK Control) and resistor R94. There is a substantial drop in signal level through the high peaking network. The signal is further amplified in transistor Q5 and applied to the gain controlled stage Q6. The VIDEO GAIN control is in the emitter circuit of transistor Q6.

Emitter follower Q9 drives the keyed clamp stage Q10 through capacitor C20. At the beginning of each horizontal line, a horizontal sync pulse triggers the keyed clamp transistor Q21. As transistor Q21 conducts, the collector-emitter resistance becomes very small, effectively placing the base of transistor Q10 at reference potential.

Since this happens for every line, each line of video information starts through transistor Q10 at the same bias potential, and a uniform black scale gradation is maintained.

Composite vertical and horizontal blanking is added to the video in the emitter of transistor Q10. The signal is amplified by transistor Q11 and applied to clipper diode CR7 which establishes the setup level. Stages Q12 and Q13 form the output amplifier, with composite sync being added in the base of transistor Q13. The output is ac coupled through capacitor C24, and source terminated by resistor R53.

c. Vertical Blanking, Sync and Drive

The power transformer winding which supplies the vidicon heater voltage also supplies the vertical sweep triggering voltage at the power line frequency. The sinusoidal wave from the transformer is clipped

by diodes CR4 and CR5. The resulting square wave is highly amplified by transistors Q25 and Q26 to produce a fast-rise, line-frequency square wave. This signal is then differentiated and used to trigger the vertical blanking monostable multivibrator which consists of transistors Q27 and Q28. The blanking signal thus developed at the multivibrator is applied to the cathode of the vidicon, and is also reshaped and mixed with horizontal blanking and then added to the video signal by transistor Q20. The same pulse is also used to drive the sawtooth generator for the vertical sweep.

The vertical blanking signal is differentiated by C34 and R85 and shaped in transistor Q29 to form a pulse of approximately 150 us duration. This pulse is used as vertical sync after being shaped by transistor Q29 and mixed with the horizontal sync.

The circuit of the vertical blanking multivibrator is described in the following paragraphs. Capacitor C31 differentiates, across R83, the square triggering pulses from transistor Q26. Diode CR6 couples the positive triggering pulses to the vertical blanking multivibrator circuit containing transistors Q27 and Q28. The multivibrator is a collector coupled, monostable circuit. In the stable state transistor Q27 is held in saturation by the positive bias supplied by resistor R80. Bias for transistor Q28 is determined by the collector potential of transistor Q27. When transistor Q27 is conducting, the positive bias on Q28 is zero and transistor Q28 remains cut off. When a positive signal appears at the base of transistor Q28, the transistor starts to conduct. A negative going pulse is coupled to the base of transistor Q27 by capacitor C32, which brings transistor Q27 toward cut off. The voltage on the collector of transistor Q27 becomes more positive, thus supplying bias to transistor Q28 to drive it further into conduction. The process continues rapidly until transistor Q27 is cut off, and transistor Q28 reaches saturation.

Initially, when transistor Q27 was conducting, capacitor C32 charged to the power supply potential through the essentially shorted base-emitter junction of forward bias transistor Q27. When transistor Q27 is cut off by the pulse from transistor Q28 the potential on capacitor C32 holds it in cut off. With the base-emitter junction of transistor Q27 no longer at ground potential, capacitor C32 is free to discharge through resistor R80. When capacitor C32 is discharged sufficiently, transistor Q27 starts to conduct and saturate again. The rate of this discharge cycle, which determines pulse width, is controlled by the time constant of capacitor C32 and resistor R80. Incoming pulses from the ac line-locked pulse amplifier and shaper transistor Q26 keep the multivibrator accurately timed. The duration of the blanking pulse is about 1100 usec.

d. Horizontal Blanking, Sync and Drive

The horizontal blanking signal which is added to the video is derived from the same horizontal pulse which drives the horizontal output stage. The horizontal drive pulse is differentiated by capacitor C29 and resistor R64. It is used to drive transistor Q16 from cutoff to saturation at the leading edge of the drive pulse. The collector circuit of transistor Q16 is a double time-constant arrangement which quickly discharges capacitor C30 during the leading edge of the horizontal drive pulse, then allows the capacitor to slowly recharge to the power supply voltage through resistors R65 and R66 during the remainder of the trace period. Transistor Q17 is switched on when capacitor C30 is discharged and remains on until capacitor C30 is recharged to a critical point, at which time transistor Q17 returns to the off state. A pulse is thus formed at the collector of transistor Q17 which is of about 10.5 us duration and is used for horizontal blanking. This pulse is shaped and inverted by transistor Q18 and mixed with vertical blanking by transistor Q19, then added to the video along with the vertical blanking signal.

Horizontal sync is developed from the negative flyback pulse present on the collector of horizontal output transistor Q50. The pulse is reduced in magnitude by resistors R149 and R150 and coupled by capacitor C54 to the base of transistor Q43. This transistor is normally held in saturation by positive bias supplied through resistor R153. During a 5 us period, the retrace pulse becomes sufficiently negative to overcome the positive bias on the base of transistor Q43, and the transistor is turned off. A pulse appears in the collector of transistor Q43 which is used as the horizontal sync pulse. The pulse is mixed with the vertical sync pulse by transistor Q23 and added to the video to form a composite signal. The slow rise time of the horizontal output flyback pulse causes the horizontal sync to be delayed slightly from the blanking pulse, thus creating a "front porch" in the output signal.

e. Vertical Sweep Generation and Output

The vertical sweep is driven by a pulse which is derived from the power line as described under paragraph c. Vertical Blanking, Sync and Drive. Transistor Q37 is normally biased to cutoff; however, when the drive pulse is applied, the transistor

is driven to saturation and the effective collector-to-emitter resistance is made low. Capacitor C38 then discharges through transistor Q37 and current limiting resistor R114. When the drive pulse ends, transistor Q37 again returns to the cutoff condition. Capacitor C38 then begins charging toward the power supply voltage through the collector of transistor Q36. Since the base current of transistor Q36 is constant, the collector current is also constant and the voltage across capacitor C38 rises very linearly with time. Due to the recurrent nature of the drive signal, the accumulated charge on capacitor C38 is periodically discharged and the voltage waveform across capacitor C38 is a linear rise sawtooth. The slope of the sawtooth is determined by the charging current magnitude, that is, the magnitude of the collector current of transistor Q36. This current is the product of the beta of the transistor and the base current. The base current is adjustable by means of the HEIGHT control. Since no feedback is required to achieve a linear sawtooth, no vertical linearity control is needed.

The voltage of the sawtooth is sufficiently high to drive the vertical yoke, but the impedance of the yoke is so low that it would load the sawtooth excessively. To avoid this, the impedance of the sawtooth is matched to the impedance of the yoke with the Darlington pair of transistors Q38 and Q39. Capacitor C39 is called a "bootstrap" capacitor that increases the input impedance of the Darlington pair by reducing the ac voltage drop across resistor R116.

f. Horizontal Oscillator and Deflection Circuits

The horizontal oscillator is a crystal-controlled multivibrator operating at 31.5 kc. When power is applied to the circuit, both transistors Q40 and Q41 are biased for conduction. Normal thermal noise generated in transistor Q40 is coupled by capacitor C45 to transistor Q41 where it is further amplified. The noise is carried from the collector of transistor Q41 to the crystal Y1 by resistor R133. Any component of the noise which happens to be at 31.5 kc is passed by the crystal to the base of transistor Q40 where it is recycled and further amplified. After several cycles, the 31.5 kc signal is of an amplitude which drives transistor Q41 from saturation to cutoff. The oscillator is then operating normally with a rectangular wave output.

The output of the oscillator is buffered by transistor Q42 which drives the divide-by-two flip-flop transistors Q46 and Q47. The divider is a bistable multivibrator. In operation, one of the transistors will be saturated and the other cutoff. Assume, for example, that transistor Q46 is saturated. The collector voltage of transistor Q46 will be low and will be approximately equal to the emitter voltage. Consequently, very little current will flow through resistor R128 so transistor Q47 will remain biased to cutoff. Since transistor Q47 is cut off, the collector voltage will be high, and substantial current will flow through resistor R137 which will keep transistor Q46 biased to saturation. The circuit is stable that is, no changes will occur unless a disturbance is introduced from outside the circuit. The input to the divider from the buffer transistor Q42 constitutes a disturbance. The rectangular pulses from the buffer will be differentiated by capacitors C46 and C47 across resistors R127 and R136, respectively. Diodes CR12 and CR13 are "steering" diodes. Their function is to direct a turn-off signal to the transistor which is in saturation while keeping any signal from reaching the transistor which is cut off. In this example, when a negative pulse reaches the junction of resistor R136, diode CR13 and capacitor C47, it will be blocked from passage through diode CR13, since the diode will be heavily reverse biased through resistors R138, R136 and R139. But diode CR12 will not be reverse biased since the collector, emitter and base voltages of transistor Q46 are approximately equal. The negative pulse will pass through diode CR12 and override the positive bias being applied through resistor R137 to the base of transistor Q46. Transistor Q46 will turn off and its collector voltage will rise, causing current to flow in resistor R128 which in turn will bias transistor Q47 to saturation. The collector voltage of transistor Q47 will rapidly fall to approximately the emitter voltage which will remove the current flowing in resistor R137 and maintain transistor Q46 in the cutoff state.

The next negative input pulse will turn off transistor Q47 and by the same process as above will turn on transistor Q46. It is seen that each succeeding negative pulse from the oscillator will reverse the condition of the two transistors, with the "on" transistor going off and the "off" transistor going on. Thus, upon examining the waveform on the collector of either transistor, it is found that for every two negative pulses into the divider, one will appear at the collector. When the output is taken at one of the collectors, it is then the input frequency divided by two. The input frequency is 31500 cps and the output is, therefore, 15750 cps. The output is differentiated by capacitor C49 across R141 and applied to the base of transistor Q48 where it is shaped to a pulse of about 10 us duration. The pulse taken from the collector Q48 is the same pulse referred to as the horizontal drive pulse in paragraph d. Horizontal Blanking Sync and Drive.

It is further buffered in transistor Q49 and coupled by capacitor C53 to the base of the horizontal outpul transistor Q50.

The horizontal output transistor is normally biased for conduction. Voltage to the emitter of Q50 is supplied through resistor R152 and variable resistor R151, the WIDTH control. This control adjusts the supply voltage available to the stage. It also establishes the maximum current that can be drawn by the collector to control the amplitude of pulses to the horizontal yoke circuitry. When transistor Q50 is cut off by the positive pulses at its base, the collapsing magnetic field of inductor L8 develops a high potential negative pulse in the collector circuit. The yoke circuitry is composed of tuning capacitor C56, coil L8, two windings of the horizontal yoke in series, and coupling capacitors C57 and C60. Transistor Q50, operating as a switch, supplies a negative current pulse to capacitor C57. This capacitor couples the pulse to coil L8 to build up a magnetic field. When transistor Q50 is conducting, the pulse disappears from coil L8 and the magnetic field collapses slowly. Current generated by the collapsing fiend enters the horizontal yoke as a linearly increasing sawtooth. Horizontal centering is provided by variable resistor R161 which controls the amount of dc current in the yoke. The tuning capacitor C56 regulates the horizontal retrace period.

g. Vidicon TARGET (Sensitivity Control)

The vidicon target voltage may be set either manually, by means of the TARGET potentiometer, or automatically through the self-contained automatic light control circuitry. When the target is set manually, the TARGET control acts as a variable voltage divider across the target supply.

The automatic circuitry consists of transistors Q3, Q4, Q14 and Q15. Emitter-follower transistor Q4 isolates the automatic control circuitry from the video amplifier. The video signal present at the emitter of Q4 is amplified by Q15 and Q3. The signal from Q3 is rectified in the voltage doubler rectifier circuit and the resultant applied to the VIDEO LEVEL potentiometer R58. The arm of the potentiometer is connected by resistor R57 to the base of the shunt regulator transistor Q14.

The video output is held steady by this circuit as follows. If the light level to the vidicon increases, the video output of the vidicon increases. This causes the dc current to the base of the shunt regulator transistor Q14 to increase, increasing the collector current and thus reducing the target voltage. The reduced target voltage causes the video output of the vidicon to be reduced, and the video level is maintained.

h. Sweep-Failure Protection Circuits

Vidicon burns due to vertical or horizontal sweep failure are prevented by circuits which remove target and accelerating voltage to disable the vidicon. Sweep failure clamp transistor Q52 is normally biased to cutoff and has no effect on the signal present at the junction of its collector with resistor R163 and the base of transistor Q51. If either vertical or horizontal sweep should fail or reduce in amplitude, the clamp transistor Q52 will be biased to saturation and will clamp the drive signal to the high voltage output stage which immediately removes target and accelerating voltage from the vidicon.

The bias to the clamp translator is controlled by two transistors Q44 and Q45. Input to transistor Q44 is derived from the vertical sweep signal at the output of the vertical sweep amplifier. Part of the vertical sweep signal is coupled by capacitor C50 from the emitter of transistor Q39 to a voltage doubler rectifier consisting of diodes CR15 and CR16, capacitor C51, and resistor R147. When the vertical sweep circuits are operating, a positive dc potential is developed across resistor R147. This positive voltage causes a current to flow in resistor R148 which is sufficiently large to saturate transistor Q44. Thus the collector of transistor Q44 will be at approximately ground potential. As a result, little of the current passing through resistor R156 is passed on through resistor R157 to the base of the clamp transistor. If the vertical sweep fails, transistor Q44 will no longer be held in saturation and its collector voltage will rise, causing current to flow through resistor R157 to the base of the clamp transistor Q52. This saturates the clamp transistor and removes high voltage from the vidicon.

Horizontal sync is developed from the horizontal flyback pulse and therefore will not be present if the horizontal sweep fails. Capacitor C58 is kept charged by diode CR18 to the peak voltage of the sync tips that are present on the collector of transistor Q43. If sync is present, this voltage will be high enough to pass a current through resistor R158 that will keep transistor Q45 in saturation. If sync is not present, Q45 will no longer be held in saturation and its collector voltage will rise, allowing enough current to flow in resistor R160 to saturate the clamp transistor.

A failure of either horizontal or vertical sweep is sufficient cause to remote the high voltage from

the vidicon with this circuit. Of course, if both should fail simultaneously, the protection will also function normally.

i. Power Supply

The 117 v, 60 cycle, ac primary power is applied to transformer T2 through a local or remote control unit power switch. One secondary winding supplies heater voltage for the vidicon. The output of another secondary winding is rectified in the bridge of diodes CR8, CR9, CR10, CR11 and filtered by capacitor C36 to provide power for the regulator circuits.

(1) Regulated 20-Volt Power Source

The rectified, unregulated voltage from transformer T2 is passed to a feedback regulator using transistors Q30, Q31 and Q32. Transistor Q30 operates as a series regulator to maintain constant output voltage. Transistor Q32 is a control transistor which senses the output voltage variations. Transistor Q31 is a current amplifier used to drive transistor Q30. The resistor (R95) from collector-to-emitter of transistor Q30 protects the transistor from high power dissipation under high line-voltage conditions.

Precision resistors R97 and R98 form a voltage divider across the regulated power supply. When the output of the regulator is exactly 20 volts, the voltage at the junction of R97 and R98 will be slightly higher than the nominal voltage of the precision zener diode CR28. At this time, the current through the base of transistor Q32 will be between a minimum of zero and a maximum which will saturate Q32. The collector voltage will accordingly be between its maximum and minimum values, and the emitter of driver transistor Q31 will follow the voltage on the collector of Q32. The output voltage on the emitter of the regulator transistor Q30 is controlled by the voltage on the emitter of the driver transistor, so the loop is now complete. If the 20-volt line tends to rise above its nominal value, the voltage at the junction of R97 and R98 will rise, increasing base current in transistor Q32. The collector voltage of transistor Q32 will drop, causing the emitter voltage of transistor Q31 to drop, which in turn causes the emitter voltage of the series regulator transistor Q30 to drop and thus offset the initial rise in output voltage. If the output voltage tends to fall, exactly the reverse effect takes place and the output voltage remains constant. Precision divider resistors and a precision Zener diode make a voltage adjustment unnecessary.

(2) High Voltage Power Source

A single transformer supplies all voltages over 20 volts magnitude of either polarity. Transformer T1 is a self-resonant transformer that is driven at the horizontal scan frequency by transistor Q53. The output of the various taps on the secondary are rectified and filtered to provide vidicon target accelerating and control grid bias voltages.

j. Focus Current Regulator

Current for the vidicon focus coil is drawn from the regulated 20-volt supply. The current is controlled by transistor Q55. If the focus coil current tends to decrease, the lower current through resistor R177 produces a lower current at the base of transistor Q54 which then increases the collector voltage of Q54. This change increases base current to transistor Q55, thus restoring the original focus coil current. The two diodes CR29 and CR31 are always forward biased and compensate for transistor variations with changes in ambient temperature. Focus coil current regulation is necessary because the resistance of the coil varies considerably as temperature changes.

6. ADJUSTMENTS AND MAINTENANCE

a. General

The following is a detailed field alignment procedure that will provide complete camera adjustments. In addition, preventive maintenance of the camera is supplied.

b. Equipment Required

(1) Camera with local or remote control.

(2) Lens (see TEST PATTERN TO LENS DISTANCE TABLE).

(3) Motorola 14" Monitor.

(4) Motorola Transistorized DC Multimeter or equivalent.

(5) RETMA Resolution Chart 1956.

(6) Crosshatch Generator.

(7) Variac.

(8) Motorola Model T1014B Precision Wideband Oscilloscope with TEKA-22 Accessory Probe.

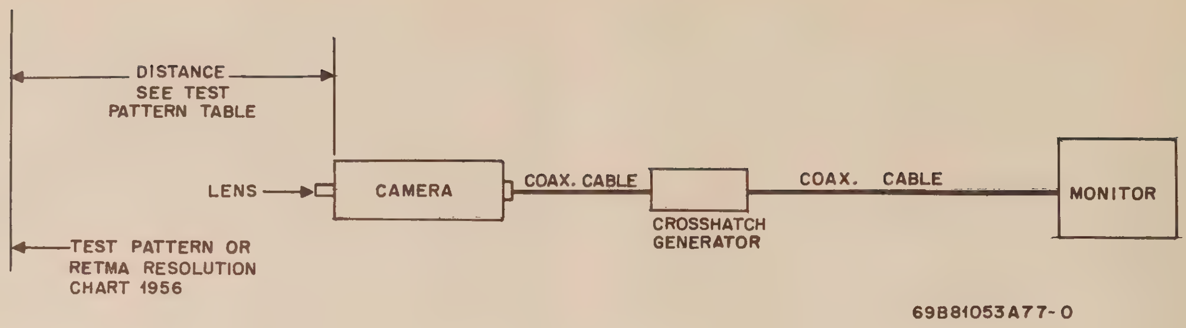


Figure 6.
Equipment Set-Up Block Diagram

c. Equipment and Test Pattern Set-Up (See Figure 6.)

A test pattern is supplied with this instruction manual and should be used for adjustments only. Detailed testing of the camera should be performed with the industry standard, RETMA Resolution Chart 1956. This chart is very expensive, and the enclosed test pattern is sufficient for all but the most critical resolution or gray scale tests.

To properly use the test pattern, it is necessary for the monitor to be correctly adjusted for linearity size and horizontal frequency. Consult the monitor instruction manual for the adjusting procedure.

Assuming a properly adjusted monitor, mount the test pattern on a wall and set the camera with the axis of the lens in line with the center of the test pattern and perpendicular to it. The distance from the test pattern to the camera lens mounting plate should be determined from the following table.

TEST PATTERN TO LENS DISTANCE

PATTERN WIDTH	LENS FOCAL LENGTH	
	1"	2"
9"	17.0"	34.0"
*12"	22.7"	45.4"
**24"	45.4"	90.8"

* Pattern Supplied
** RETMA Resolution Chart 1956

NOTE
These distances scan a vidicon area 9/16" wide.

d. Mechanical Adjustments

(1) Check vidicon for proper rotation within deflection yoke. If necessary, grasp vidicon in rear and rotate. Use the short pin on the vidicon socket as a guide. The pin viewed from the back should be located at the 3 o'clock position. (See Figure 7.)

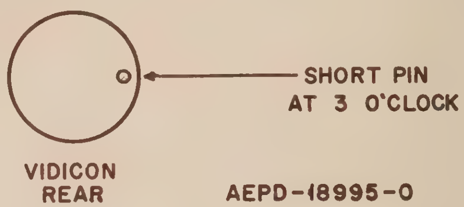


Figure 7.
Vidicon Horizontal Line Guide

(2) Attach a piece of 75-ohm coaxial cable between the camera and the crosshatch generator.

(3) Attach a piece of coaxial cable between the generator and the monitor.

(4) The monitor must be terminated.

(5) Place the camera in the alignment jig (if used) and verify the distance between the lens mounting plate and the test pattern. Refer to the table.

(6) Set up a test pattern illumination of 30 foot-candles.

(7) Set the lens iris collar to the widest opening (maximum aperture).

(8) Set the lens focus collar to the proper distance.

(9) Set BEAM control to maximum counter-clockwise position.

e. Electrical Adjustments

(1) Turn camera and monitor ON and allow 10 minutes warm-up time.

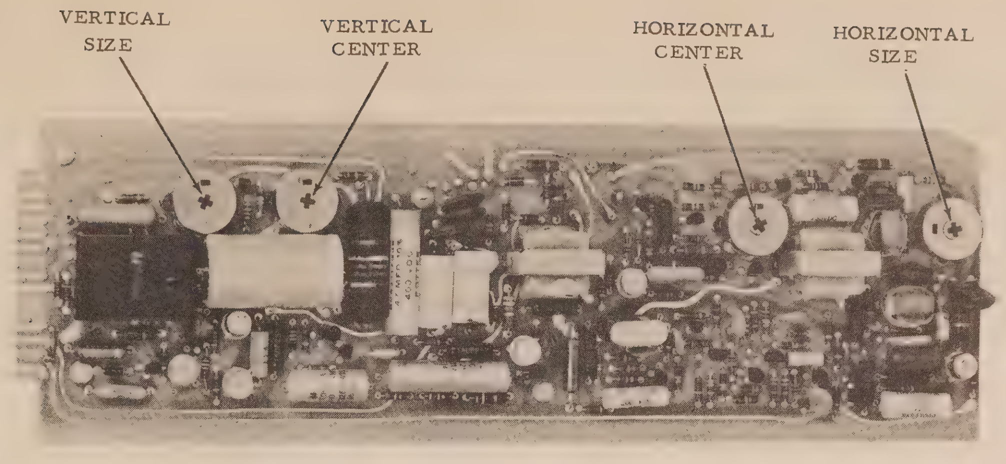


Figure 8.
Power Supply and Deflection Board

(2) Rotate the HORIZONTAL SIZE and VERTICAL SIZE controls to their mid-range positions. Refer to Figure 8.

NOTE

The 20-volt dc will remain constant as the line voltage is varied from 100 volts ac to 130 volts ac.

(3) Set FOCUS control to mid-range position.

(4) Set the OFF-MAN-AUTO selector switch on the control unit to the AUTO position.

(5) Uncap the lens.

(6) Adjust the BEAM control to resolve the highlights (turn knob clockwise until the picture just appears normal).

(7) Adjust the FOCUS control for maximum picture resolution.

(8) Set the lens focus collar to the proper distance.

(9) Set the lens iris collar for the widest opening (smallest F number).

(10) Adjust the focus screw, located beneath the lens mounting plate, for best optical focus.

(11) From this point on, adjust the optical focus via the lens collar.

(12) Reduce the monitor raster using horizontal size, vertical size, and vertical linearity controls.

(13) Adjust the picture for proper horizontal size using the test pattern diagram. Refer to Figure 9.

(a) Rotate the HORIZONTAL SIZE control until the arrowheads on one side of the picture just touch the edge of the raster. Refer to Figure 9.

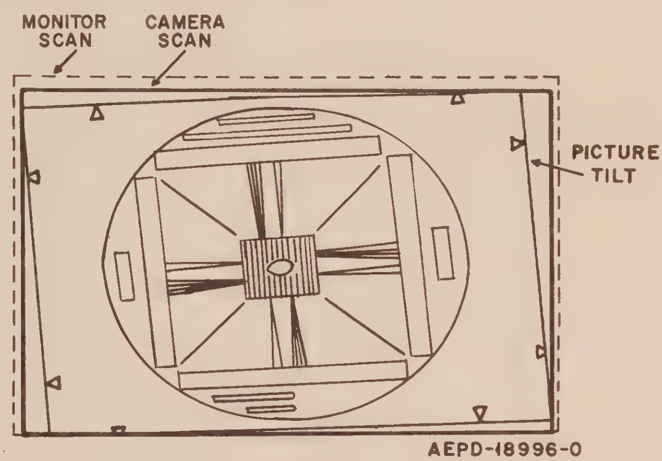


Figure 9.
Test Pattern Diagram

(b) Rotate the HORIZONTAL CENTER control until the image is centered in the reduced raster area.

(c) If necessary, adjust the picture tilt. Refer to Figure 10.

1. Remove the power and deflection board.

2. Loosen yoke screw next to beam magnet. Refer to Figure 10.

3. Replace the power and deflection boards.

4. Twist the deflection yoke for proper alignment.

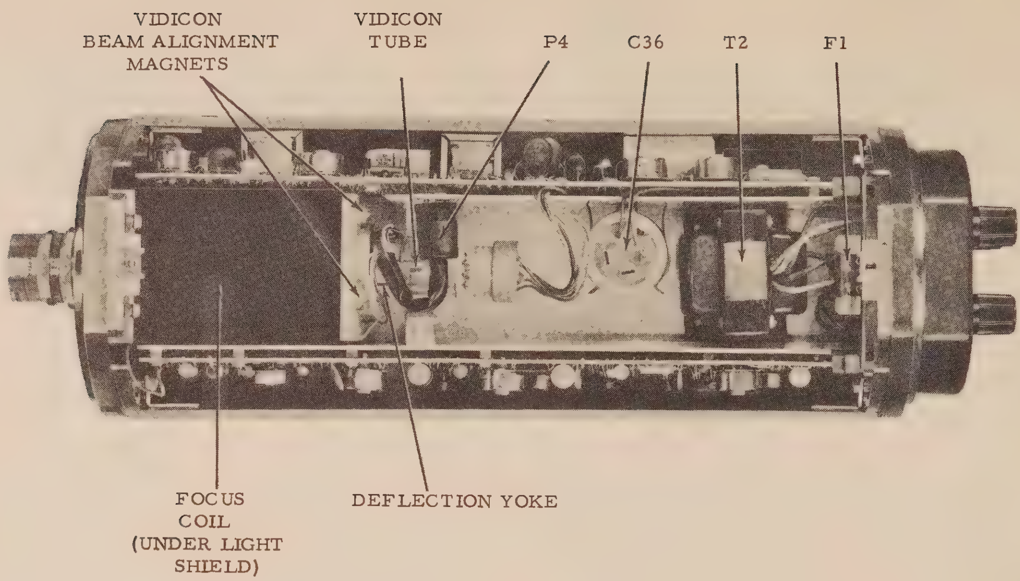


Figure 10.
Camera View with Cover Removed

5. Maintain proper vidicon positioning while tightening clamp. Refer to Figure 7.

(d) Repeat Steps (a), (b) and (c), as necessary so that the test pattern arrowheads just touch both vertical edges (sides) of the raster.

(14) Adjust the picture for proper vertical size using the HEIGHT and VERTICAL CENTER controls.

(a) Rotate the VERTICAL SIZE control until either the top or bottom set of arrowheads touches the respective edge of the raster.

(b) Rotate the VERTICAL CENTER control until the picture is centered.

(c) Readjust height and centering so that the test pattern arrowheads just touch the top and bottom of the raster.

(15) Test linearity and geometry by superimposing the crosshatch generator signal upon the camera presentation on the monitor.

(a) Adjust the crosshatch generator so that one of the horizontal lines passes through the dot in the center of the test pattern.

(b) Adjust the VERTICAL SIZE control for the conditions shown in Figure 11.

(16) Remove the crosshatch generator.

(17) Check the optical alignment (if no fixture used).

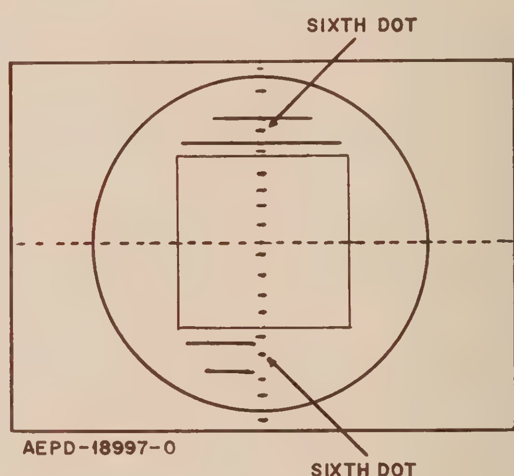


Figure 11.
Crosshatch Test Pattern Diagram

(a) Adjust the HORIZONTAL SIZE control for maximum scan (control turned fully clockwise).

(b) Adjust the VERTICAL SIZE control for maximum scan (control turned fully clockwise).

(c) Adjust the camera housing so that the test pattern falls in the center of the vidicon faceplate as viewed on the monitor. Refer to Figure 12.

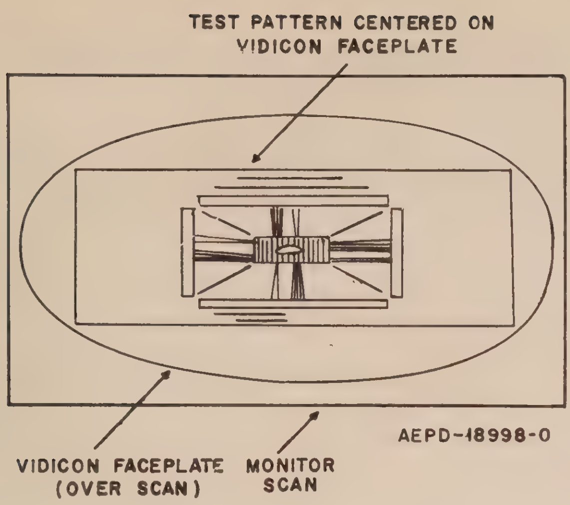


Figure 12.
Centered Test Pattern Diagram

(d) Check for the proper distance from lens mounting plate to test pattern.

(e) Readjust the VERTICAL SIZE and HORIZONTAL SIZE controls of the camera for proper scan. The pattern arrowheads should be at the edges of the monitor scanned area.

(18) Align the beam magnets using the test pattern.

(a) Procedure With Wobbulator (Not Supplied)

1. Attach the Wobbulator as shown in Figure 13.

2. Adjust the beam magnets (shown in Figure 10) by loosening the holding screws and rotating them.

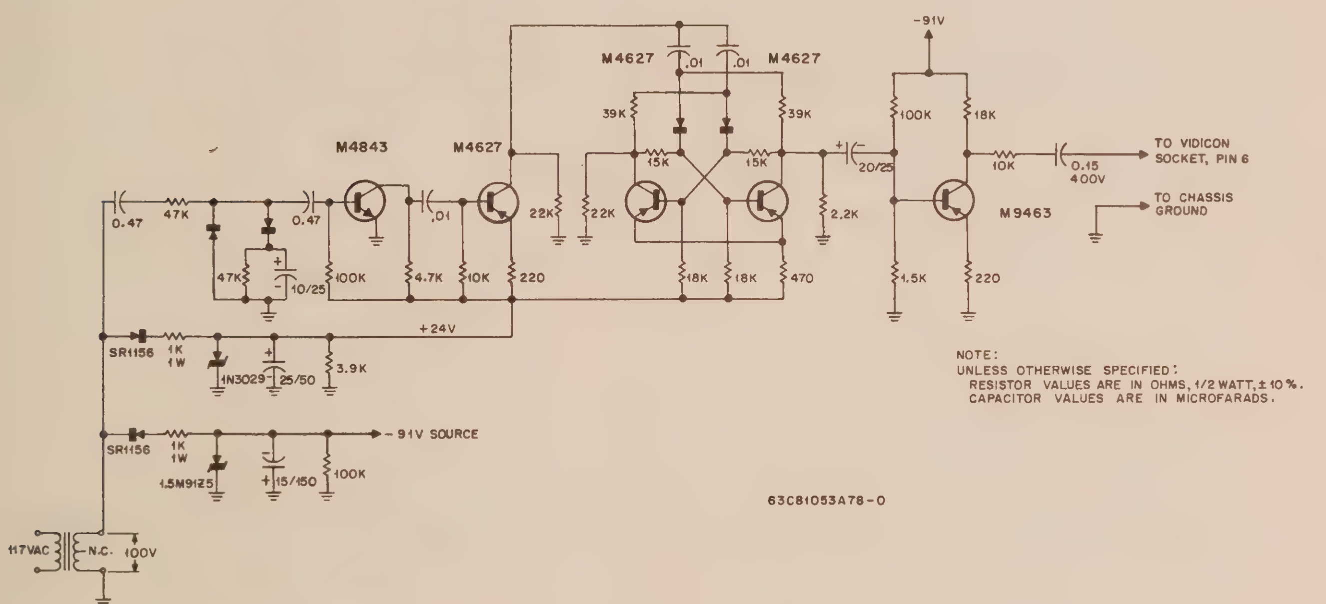


Figure 13.
Wobbulator Circuit

3. Adjust the beam magnets for superposition of the center circle as shown in Figure 14.

4. Adjust the beam magnets for equal rotation of the diagonal lines while holding the center in superposition.

5. Fasten the beam magnets in position by tightening the holding screws. Be careful not to allow the magnets to slit out of position.

6. Readjust vertical and horizontal centering as required.

7. If necessary, adjust picture tilt.

8. Adjust the monitor to full raster.

(b) Procedure Without Wobbulator

1. Rotate the FOCUS control on the local or remote control unit so that the picture passes on both sides of optimum adjustment.

2. Adjust the beam magnets (shown in Figure 10) by loosening the holding screws and rotating them.

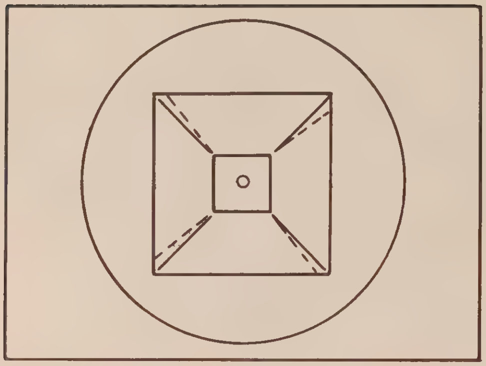


Figure 14.
Vidicon Beam Alignment Diagram

3. Rotate both beam magnets (see Figure 14) so that the center circle of the test pattern remains in a fixed position as the FOCUS control is rotated quickly back and forth.

4. Fasten the beam magnets in position by tightening the holding screws. Be careful not to allow the magnets to slip out of position.

5. Readjust vertical and horizontal centering as required.

6. If necessary, adjust picture tilt.

7. Adjust the monitor to full raster.

(19) Video Signal Adjustments

(a) Manual Target Adjustment

1. Adjust the lens iris collar to F/2.8.

2. Move the OFF-MAN-AUTO switch on the control unit to the MAN position.

3. Adjust the BEAM, TARGET and FOCUS controls on the control unit for the best possible picture.

4. Adjust the TARGET control for 0.12 volt p-p of signal at the base of Q6, the transistor in the gain control stage.

5. Check this video signal for the presence of both horizontal and vertical vidicon blanking pulses.

(b) Automatic Target Adjustment

1. Move the OFF-MAN-AUTO switch on the control unit to the AUTO position.

2. Adjust the VIDEO LEVEL control (see Figure 15) for 0.12 volt p-p of signal at the base of transistor Q6.

3. Adjust the BEAM control to the "wipe" condition for best picture.

4. Move the OFF-MAN-AUTO switch back and forth between MAN and AUTO positions. There should be no noticeable change in the picture.

(c) SET-UP Adjustment

1. Set-up refers to the distance between the blacks in the video signal and the blanking level. This should be set while viewing the output signal on an oscilloscope. Adjust the SET-UP control so that the distance between the maximum

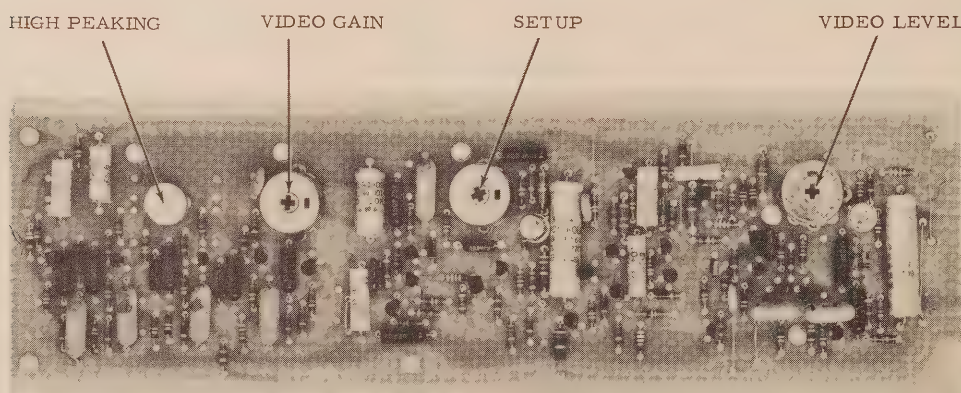


Figure 15.
Video Amplifier Board

picture blacks and blanking level is about 0.2 volt. (See Figures 15 and 16.)

2. In the event that scope presentation is not available, simply adjust the SET-UP control to the point at which detail in the darker areas of the picture is not lost (as viewed on a monitor).

(d) Composite Video Signal Alignment

1. Connect an oscilloscope to the center lead of the video output jack J4. Be certain that the camera output is terminated in 75 ohms.

2. Test the maximum composite video signal output level.

a. Set the lens iris collar to f/2.8.

b. Turn the VIDEO GAIN control (see Figure 15) clockwise until the signal at the video output jack reaches 1.7 volt p-p.

3. Check the sync amplitude for 0.5 volt.

NOTE

Set-up voltage will vary depending on vidicon age, lighting conditions and video amplifier tolerances.

(e) High Frequency Response Alignment

1. Set the lens iris collar to f/2.8.

2. Check the test pattern illumination.

3. Adjust the monitor brightness control for a fairly dark picture.

4. Adjust the HIGH PEAK trimmer (see Figure 15) so that the monitor picture shows no trailing blacks or whites or the horizontal or mid-frequency bars of the test pattern. The horizontal low or mid-frequency test bars are the heavy, black, horizontal bars at the bottom of the large circle.

(20) Video Output Transistor Check

(a) Unterminate the camera by removing coaxial connection to the monitor.

(b) Short the video output to ground several times.

(c) Reterminate the camera and check the waveform at the video output jack J4.

(d) There should be no change in the waveform what it was before the shorting took place.

(e) Cap the lens and check for low frequency noise. This shows up as light and/or dark horizontal streaks or bars on the monitor screen.

(f) Check for dirt on the lens and vidicon faceplate. Clean them if necessary.

1. Set the lens down to f/16.

2. Set lighting illumination to maximum.

3. Check monitor for presence of dirt on lens or vidicon faceplate.

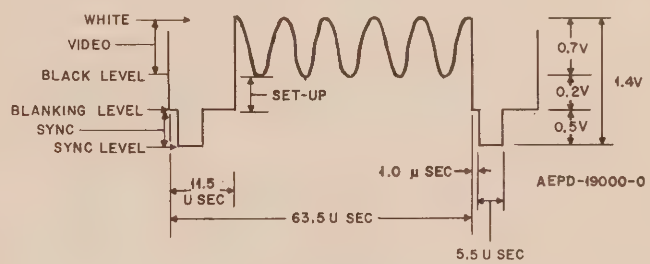


Figure 16.
One TV Line of Composite Video Information

f. Vidicon Target Erasure (Clearing Target of Retentive Image)

Two methods can be used for erasing retained images which are the result of a camera remaining fixed on a stationary object for long periods.

Method (1) can be used in the field, as it is easily performed without removing the c from its mounting. This method can also be used as a regularly scheduled part of maintenance to insure satisfactory results when image retention is objectionable.

Method (2) can be used as a corrective procedure when the camera is dismounted and brought into the shop. In some stubborn cases of severe image retention it may be necessary to use both methods to obtain a satisfactory erasure.

(1) Preventive Maintenance

(a) Cap lens so that no light falls on vidicon faceplate.

(b) With camera operating, select the MAN (manual) mode of sensitivity adjustment, and rotate the TARGET control to the fully clockwise position for maximum target voltage. (About +120 volts in extreme clockwise position.)

(c) Adjust BEAM control to obtain a uniformly white picture on the monitor making certain there are no distortions or predominant dark areas in the picture. This generally occurs in the center of the BEAM control range.

(d) Operate in this manner for one minute if this is a regularly scheduled part of maintenance.

A longer erasure time may be required if the image retention is severe.

(e) Return camera to normal operating mode.

(2) Corrective Maintenance

(a) Remove lens and evenly illuminate the vidicon target with a 150-watt flood lamp at a distance of about 7-inches from the camera.

(b) With camera operating, select the MAN (manual) mode of sensitivity adjustment and set TARGET control for +100 volts. (Measured at the Target Voltage Test Point)

(c) Adjust BEAM control to resolve the white area without introducing any distortion in the monitor picture. This generally occurs in the center of the BEAM control range.

(d) Operate in this manner for as long as is necessary to obtain erasure (30 minutes should be satisfactory for most cases. Do not exceed 2 hours.)

(e) Return camera to normal operating mode.

NOTE

These methods cannot be used for clearing the vidicon target for sun burns or burns caused by other very intense light.

g. Vidicon Replacement

(1) Loosen the screws at each end of the top cover and remove the top cover from the camera.

(2) Remove the lens mounting plate from the front of the camera by removing the four mounting screws.

(3) Grasp the back of the vidicon with one hand and with the other hand, remove the vidicon socket.

(4) A small metal clip holds the vidicon in from the front. Loosen the screw that holds this clip, and swing the clip away from the vidicon faceplate.

(5) Push the vidicon through the front of the camera.

(6) Put the new vidicon in the camera. The short pin should be in the 3 o'clock position when viewed from the rear of the camera.

(7) Grasp the vidicon with one hand and with the other hand, push on the vidicon socket.

(8) Swing the front clip over the faceplate of the vidicon and tighten the screw holding this clip. Do not overtighten this screw as there is danger of vidicon breakage.

(9) Replace the lens mounting plate and install a lens.

(10) Connect the camera to a monitor and turn down the BEAM control (fully counterclockwise). Aim the camera at the test pattern and perform the beam alignment procedure described in Step 19 of the ADJUSTMENTS AND MAINTENANCE section of this manual.

(11) Turn off the camera and install the top cover on the camera.

7. TROUBLESHOOTING

a. General

If any failure should occur in the camera, a qualified serviceman should perform the troubleshooting and repair. An understanding of the OPERATING INSTRUCTIONS, CIRCUIT DESCRIPTION and ADJUSTMENTS AND MAINTENANCE is essential for efficient troubleshooting.

In any case of malfunction, fuses, power sources and system intercabling should be checked. The monitor(s) controls should be set for normal operating levels with the monitor (or last monitor in chain) properly terminated. Refer to monitor instruction manual.

If the malfunction still persists, check operating control settings as a possible cause. Symptoms of improper control settings are described in paragraph c.

Then proceed with preliminary visual inspection of circuit components. Look for overheating, discoloration or loose parts and connections. If all appears normal, follow the steps outlined in the Preliminary Test Procedure paragraph d. It will help localize the malfunction to chassis mounted components or to one of three circuit boards.

Once the trouble area has been localized, refer to the Service Aids paragraph for detailed circuit and troubleshooting information.

Before proceeding with camera servicing, it will be helpful to review transistor operation, symbols and normal biasing.

Two basic types of transistors are used in the Motorola camera. They are the P-N-P and N-P-N shown symbolically in Figure 17. These transistors consist of two junctions with the base common to both. The base-emitter junction is normally conducting, and the base-collector junction is normally non-conducting. For this condition to exist, the collector circuit battery must have a higher voltage than the battery between the emitter and the base. Figure 18 shows a simplified circuit using a P-N-P type transistor.

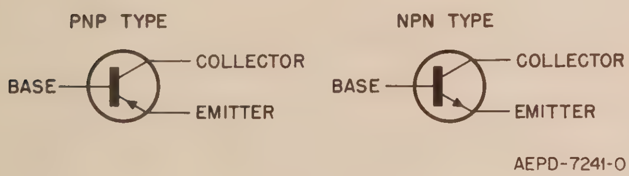


Figure 17.
Transistor Symbols

Since the base-emitter junction is conducting, the emitter and base will be at approximately the same potential. The base in this case will be in the order of a few tenths of a volt more negative than the emitter. The base-collector junction, however, is non-conducting and the collector will be in the order of a few volts more negative than the base (or emitter, since the base and emitter are at the same potential).

A similar situation exists with N-P-N type transistors; however, the polarities are reversed.

There are many exceptions to "normal" biasing such as in stages that are driven into cut-off or saturation. While in saturation, all terminals of the transistor (base, collector, emitter) can be about the same potential. In cut-off, the base can be more positive (P-N-P transistor) than the emitter.

Most of the transistors in the Motorola camera are "normally" biased by the use of resistive dividers from the power supply or by using potentials established in previous stages.

b. Test Equipment Required

(1) Motorola Model T1014B Oscilloscope with accessory TEKA-22 High Impedance Attenuator Probe or any quality oscilloscope with a calibrated time base.

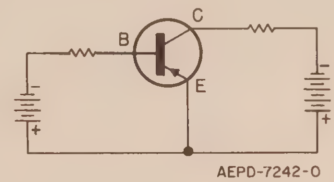


Figure 18.
Simplified Transistor Circuit

(2) Television dot or crosshatch generator.

(3) Standard Motorola Test Pattern (included with this manual).

(4) Variable voltage autoformer (to adjust power line voltage).

(5) AC-DC high impedance voltmeter.

(6) Monitor raster reducer. No reducer is needed when using Motorola Monitor Models S1101C/W, C1102C/W or S1127A. Picture size controls have sufficient range to reduce the raster for camera adjustments.

c. Improper Operating Control Settings

Apparent malfunction can result from improper operating control settings or lighting conditions. Before attempting to service the camera review paragraph 3. OPERATING INSTRUCTIONS and check the symptoms and causes listed in the following paragraphs.

(1) No Picture

BEAM setting too low. Sensitivity TARGET setting too low when in MANual position.

(2) Poor Contrast

Insufficient illumination on scene. Sensitivity TARGET setting too low when in MANual position. Lens stopped down too much. Monitor contrast setting too low.

(3) Poor Focus

Optical focus setting. Beam setting too high. Dirty lens. Sensitivity TARGET setting too high when in the MANual position. Electrical focus setting incorrect.

(4) Poor Resolution

Electrical FOCUS incorrect or BEAM setting too high. Sensitivity TARGET setting too high when in the MANual position.

(5) High Image Retentivity

Insufficient illumination on scene or lens opening too small. Sensitivity TARGET setting too high when in the MANual position.

d. Preliminary Test Procedure

When it has been determined that system intercabling, fuses or control settings are not responsible for camera malfunction, remove camera from its housing and follow the Preliminary Test Procedure Chart for the necessary chassis tests.

When the malfunction section has been located, refer to the Service Aids paragraph to make a detailed circuit analysis.

If the camera must be restored to normal operation quickly, the serviceman can simply replace the entire defective circuit board as outlined in the Preliminary Test Procedure Chart in the following paragraphs.

e. Circuit Board Replacement

Though transistors are inherently reliable devices, camera shut-down can result because of possible transistor or other component failure. However, such shut-downs have been reduced to a minimum by the removable circuit board design of the Motorola camera. Any defective circuit board can be replaced in just a few minutes. Access to the two printed circuit boards is by removing the two end screws at the top of the camera housing, then lifting the cover from the bottom section.

(1) Power and Deflection Circuit Board

Loosen hex head bolt holding the circuit board to the camera chassis. Remove yoke and vidicon sockets. Slide the board toward the lens end of camera and lift vertical board from camera chassis.

(2) Video Board

Unsolder vidicon lead. Loosen hex head bolt holding the video board to the camera chassis and slide board toward the lens end of camera. When putting the new circuit board in place, be certain that the bolt is tightened securely to ensure a good ground connection for the video circuits. Resolder vidicon lead.

f. Service Aids

This paragraph provides several aids to servicing the Motorola camera. Review them carefully, then follow normal troubleshooting procedure.

When the defective component has been located, it must be removed and carefully replaced with an exact duplicate. Install the camera in the closed circuit television system and check the adjustment of any chassis control which might have been initially readjusted in an attempt to restore the malfunctioning camera.

(1) Detailed Camera Schematic Diagram

The shcematic diagram contains complete circuit information, with part reference numbers which indicate the physical location of the part with reference to the two circuit boards and the camera chassis. Voltages and waveforms are also provided to aid the qualified serviceman in localizing trouble to a stage or component.

(2) Circuit Board Detail Diagrams

These diagrams show the location of all components on the printed circuit boards.

(3) Parts List

Replace any defective components with the exact type shown in the Parts List on the back of the camera schematic. Replacement with the exact Motorola part will assure optimum camera performance.

(4) Use of the Motorola Model T1014B Oscilloscope

The Motorola Model T1014B Oscilloscope with a Model TEKA-22 High Impedance Attenuator Probe was used to determine the waveforms shown on the camera schematic diagram.

(5) Operating Instructions for SLN6176A Servicing Module

The Model SLN6176A Service Extender is intended for use in troubleshooting the Model S1140A Camera Circuit Boards. However, the Extender is not intended for use when the video amplifier is defective since the video amplifier can be troubleshot with the circuit board in the normal position.

CAUTION

When using the service extender, the picutre may show signs of noise or oscillation. This is common since the circuits are not properly shielded when the extender is used.

The service extender is intended for use whenever a defective circuit cannot be reached with a probe when the circuit board is in the camera housing. All waveforms, except those of the video amplifier, will be unchanged when the extender is being used.

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The symptoms indicated in tl
particular circuit board or comp

Some problems which arise i
example, loss in resolution can r
In these instances, only a careful

Before using this test procedu
are properly connected. Apparen
operating controls. It is therefo
procedure to make the adjustmen

If the malfunction still persi

If the camera must be returne
circuit board, refer to the paragr
tions. Only a few minutes is req

1. AC-DC Voltmeter
2. Local Control Kit, Model SC
3. Video Monitor

If the camera has video outpu
the test indicated.

If the camera has no video ou
voltage is low or absent proceed wi

TEST	SYMPTOM	CH
1	Stationary spots	Spots r cleanir
2	Vert. size greatly expanded	Infinite P4, co 200 oh contact
3	No Horiz. or Vert. Sync Video & Blanking OK	
4	No Vert. Sync (Video, Blanking, Horiz. Sync OK)	
5	No Horiz. Sync Video, Blanking, Vert. Sync OK	
6	No Vert. Blanking Video, Sync OK	

REPLACE C TROUBLESH
ver & Deflect
ver & Deflect
eo Board
riz. Board
ver & Deflect
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an Target Rin

7 VOLTS SU

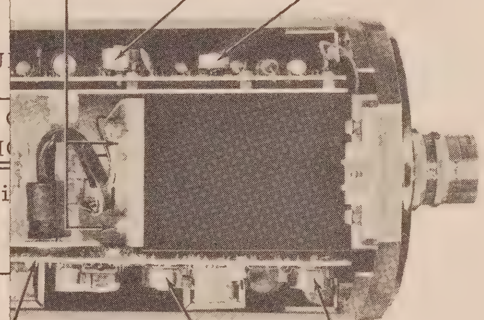
REPLACE C TROUBLESH
ver & Deflecti

VIDEO, -17 V

SULTS	RE TRO
	Vide
volts sent	Vidi
volts ent	Pow Boar

REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
& Deflection Board	Vert. Amplifier
	Horiz. osc. or Output
& Deflection Board	High voltage rectifiers output stage
yoke	
Board	Horiz. yoke circuitry

N DIAGRAM



(3) Poor Focus

Optical focus setting. Beam setting too high. Dirty lens. Sensitivity TARGET setting too high when in the MANual position. Electrical focus setting incorrect.

(4) Poor Resolution

Electrical FOCUS incorrect or BEAM setting too high. Sensitivity TARGET setting too high when in the MANual position.

(5) High Image Retentivity

Insufficient illumination on scene or lens opening too small. Sensitivity TARGET setting too high when in the MANual position.

d. Preliminary Test Procedure

When it has been determined that system intercabling, fuses or control settings are not responsible for camera malfunction, remove camera from its housing and follow the Preliminary Test Procedure Chart for the necessary chassis tests.

When the malfunction section has been located, refer to the Service Aids paragraph to make a detailed circuit analysis.

If the camera must be restored to normal operation quickly, the serviceman can simply replace the entire defective circuit board as outlined in the Preliminary Test Procedure Chart in the following paragraphs.

e. Circuit Board Replacement

Though transistors are inherently reliable devices, camera shut-down can result because of possible transistor or other component failure. However, such shut-downs have been reduced to a minimum by the removable circuit board design of the Motorola camera. Any defective circuit board can be replaced in just a few minutes. Access to the two printed circuit boards is by removing the two end screws at the top of the camera housing, then lifting the cover from the bottom section.

(1) Power and Deflection Circuit Board

Loosen hex head bolt holding the circuit board to the camera chassis. Remove yoke and vidicon sockets. Slide the board toward the lens end of camera and lift vertical board from camera chassis.

(2) Video Board

Unsolder vidicon lead. Loosen hex head bolt holding the video board to the camera chassis and slide board toward the lens end of camera. When putting the new circuit board in place, be certain that the bolt is tightened securely to ensure a good ground connection for the video circuits. Resolder vidicon lead.

f. Service Aids

This paragraph provides several aids to servicing the Motorola camera. Review them carefully, then follow normal troubleshooting procedure.

When the defective component has been located, it must be removed and carefully replaced with an exact duplicate. Install the camera in the closed circuit television system and check the adjustment of any chassis control which might have been initially readjusted in an attempt to restore the malfunctioning camera.

(1) Detailed Camera Schematic Diagram

The shcematic diagram contains complete circuit information, with part reference numbers which indicate the physical location of the part with reference to the two circuit boards and the camera chassis. Voltages and waveforms are also provided to aid the qualified serviceman in localizing trouble to a stage or component.

(2) Circuit Board Detail Diagrams

These diagrams show the location of all components on the printed circuit boards.

(3) Parts List

Replace any defective components with the exact type shown in the Parts List on the back of the camera schematic. Replacement with the exact Motorola part will assure optimum camera performance.

(4) Use of the Motorola Model T1014B Oscilloscope

The Motorola Model T1014B Oscilloscope with a Model TEKA-22 High Impedance Attenuator Probe was used to determine the waveforms shown on the camera schematic diagram.

(5) Operating Instructions for SLN6176A Servicing Module

The Model SLN6176A Service Extender is intended for use in troubleshooting the Model S1140A Camera Circuit Boards. However, the Extender is not intended for use when the video amplifier is defective since the video amplifier can be troubleshot with the circuit board in the normal position.

CAUTION

When using the service extender, the picutre may show signs of noise or oscillation. This is common since the circuits are not properly shielded when the extender is used.

The service extender is intended for use whenever a defective circuit cannot be reached with a probe when the circuit board is in the camera housing. All waveforms, except those of the video amplifier, will be unchanged when the extender is being used.

I. USE OF PRELIMINARY TEST PROCEDURE

The symptoms indicated in this procedure cover decisive malfunctions which can be localized to a particular circuit board or component with the associated tests.

Some problems which arise may not be easily diagnosed with the preliminary test procedure. For example, loss in resolution can result from a weak vidicon tube, video circuits, voltage regulation, etc. In these instances, only a careful circuit analysis using specialized test equipment can locate the trouble.

Before using this test procedure, be certain system intercabling power sources, fuses and monitors are properly connected. Apparent malfunction can result from improper setting of camera or monitor operating controls. It is therefore necessary to review the effects of control settings and the proper procedure to make the adjustments.

If the malfunction still persists, use this Preliminary Test Procedure to localize the trouble.

If the camera must be returned to service quickly and the malfunction has been isolated to a particular circuit board, refer to the paragraph on CIRCUIT BOARD REMOVAL AND REPLACEMENT for instructions. Only a few minutes is required to remove and replace any circuit board.

II. TEST EQUIPMENT REQUIRED

1. AC-DC Voltmeter
2. Local Control Kit, Model SCN6127A
3. Video Monitor

III. TEST PROCEDURE

If the camera has video output, use TEST GROUP I. Locate the symptom which applies and make the test indicated.

If the camera has no video output, check for -17 v dc at J405, contact 2 and at J404, contact 10. If voltage is low or absent proceed with TEST GROUP II. If -17 v dc is present, proceed with TEST GROUP III.

TEST GROUP I VIDEO PRESENT

TEST	SYMPTOM	CHECK FOR	REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
1	Stationary spots	Spots remain after cleaning vidicon face.	Vidicon tube	
2	Vert. size greatly expanded	Infinite resistance on P4, contacts 3 and 7.	Vert. yoke	
		200 ohms on J405, contacts 3 and 7.	Power & Delfection Board	Vert. sweep amplifiers
3	No Horiz. or Vert. Sync Video & Blanking OK		Video Board	Sync Mixer
4	No Vert. Sync (Video, Blanking, Horiz. Sync OK)		Video Board	Pulse Shaper, Vert. Blanking Mult.
5	No Horiz. Sync Video, Blanking, Vert. Sync OK		Video Board	Horiz. Sync Shaper
6	No Vert. Blanking Video, Sync OK		Video Board	Vert. Blanking Mixer

TEST GROUP I (CONT'D)

TEST	SYMPTOM	CHECK FOR	REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
7	Vert. Centering shifted suddenly. Video, Sync, Blanking OK.	Vert. Center control does not correct shift	Power & Deflection Board	Vert. Output Amp or Centering control
8	Horiz. Centering shifted suddenly. Video, Sync, Blanking OK.	Horiz. Center control does not correct shift	Power & Deflection Board	Horiz. Centering control
9	No sensitivity regulation in AUTOMATIC operation. Video, Sync, Blanking OK.		Video Board	Signal Amplifier
10	Sudden change in width or horiz. linearity	Changing Width control does not correct symptom.	Horiz. Board	Horiz. yoke or L8
11	Vert. size or linearity abnormal	Changing Height does not correct symptom	Power & Deflection Board	Vert. Sweep Amplifier
12	Electrical FOCUS control (on control unit) has no effect.		Power & Deflection Board	Focus Regulator Circuit
13	Noise	Noise from vidicon.	Clean Target Ring contact	Target contact

TEST GROUP II NO VIDEO, -17 VOLTS SUPPLY LOW OR ABSENT

TEST	SYMPTOM	CHECK FOR	REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
1	20 volt test point shows low or no voltage.	29 v absent at collector of Q30	Power & Deflection Board	Power transformer, diodes, etc.

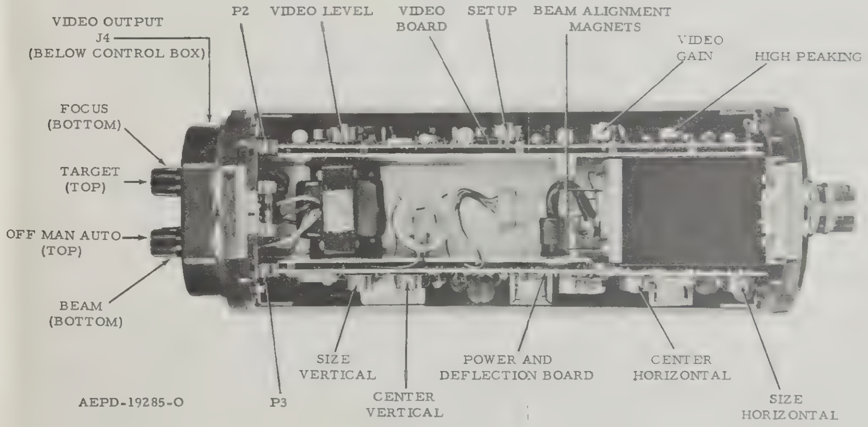
TEST GROUP III NO VIDEO, -17 VOLTS PRESENT

STEP	TEST 1	RESULTS	TEST 2	RESULTS	REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
1	Touch P401 (pin on orange lead)	No noise in video output			Video Board	Video amplifier circuits
		Noise in video output	Perform following step 2			
2	Check for lit vidicon filament	Vidicon filament is not lit.	Test for 6-7 v ac across vidicon pin 8 to ground.	6-7 volts present	Vidicon tube	Tube filament
				6-7 volts absent	Power Supply Board	Power transformer T2
		Vidicon filament is lit.	Perform following step 3.			

TEST GROUP III (CONT'D)

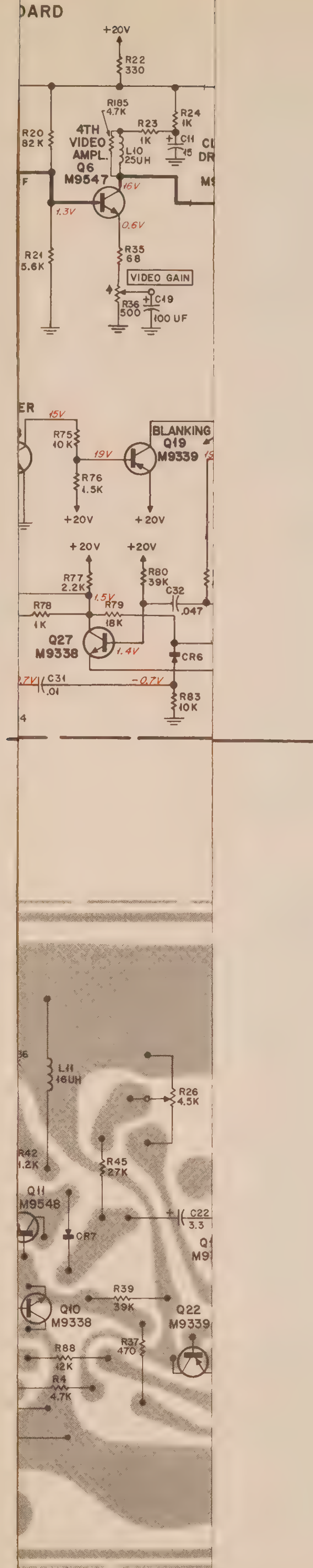
STEP	TEST 1	RESULTS	TEST 2	RESULTS	REPLACE OR TROUBLESHOOT	PROBABLE AREA AFFECTED
3	Check for target voltage J404 cont. 9 (4-90 v dc)	No voltage			Power & Deflection Board	Vert. Amplifier
						Horiz. osc. or Output
		Target voltage present	Test for high voltage at vidicontacts 5 and 6 (400 v range)	Voltage present. Perform step 4		
				No voltage	Power & Deflection Board	High voltage rectifiers output stage
4	Check resistance P4 contact 4 to 5	Infinite			Horiz. yoke	
		2 ohm			Horiz. Board	Horiz. yoke circuitry

CONTROL AND TEST POINT LOCATION DIAGRAM



AEPD-19285-O

Preliminary Test Procedure Chart
Motorola No. EPD-19003-O
6/16/67-UP



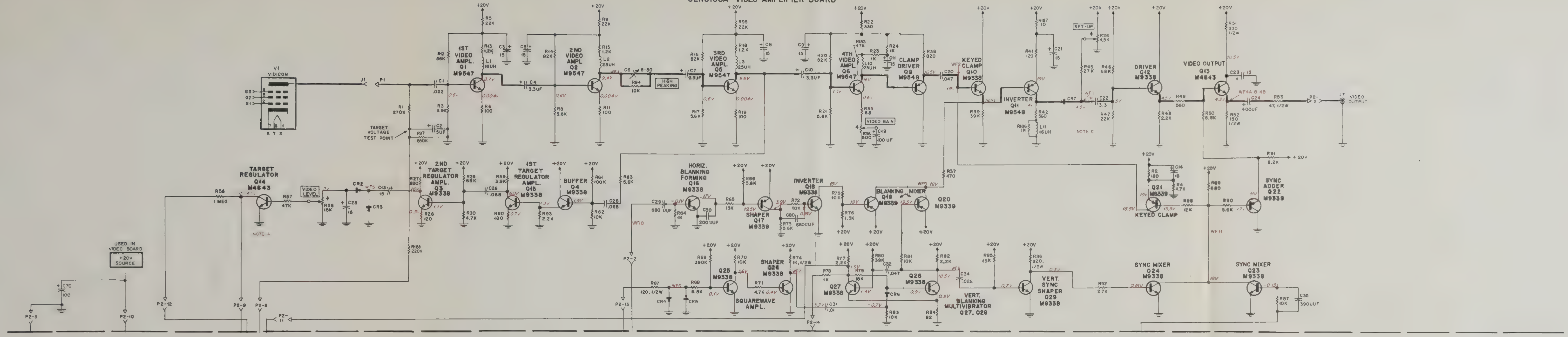
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. COMPONENTS LOCATED ON LOCAL OR REMOTE CONTROL UNIT.
3. DIRECTION ARROWS ON CONTROLS DENOTE CLOCKWISE ROTATION.
4. EXPLANATION OF CIRCUIT BOARD EDGE-CONNECTIONS:
   A. P2 = VIDEO AMPLIFIER BOARD (MATES WITH J2).
   B. P3 = POWER SUPPLY AND DEFLECTION BOARD. (MATES WITH J3).
   C. P1 = VIDICON TARGET.
   D. P4 = YOKE COILS. (MATES WITH J4).

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Video Amplifier, Model SLN6166A-4
Circuit Board Detail
Motorola No. EPD-19020-D
3/1/68-UP

SLN6166A VIDEO AMPLIFIER BOARD



NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. COMPONENTS LOCATED ON LOCAL OR REMOTE CONTROL UNIT
3. DIRECTION ARROWS ON CONTROLS DENOTE CLOCKWISE ROTATION
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   A. P2 = VIDEO AMPLIFIER BOARD (MATES WITH J2).
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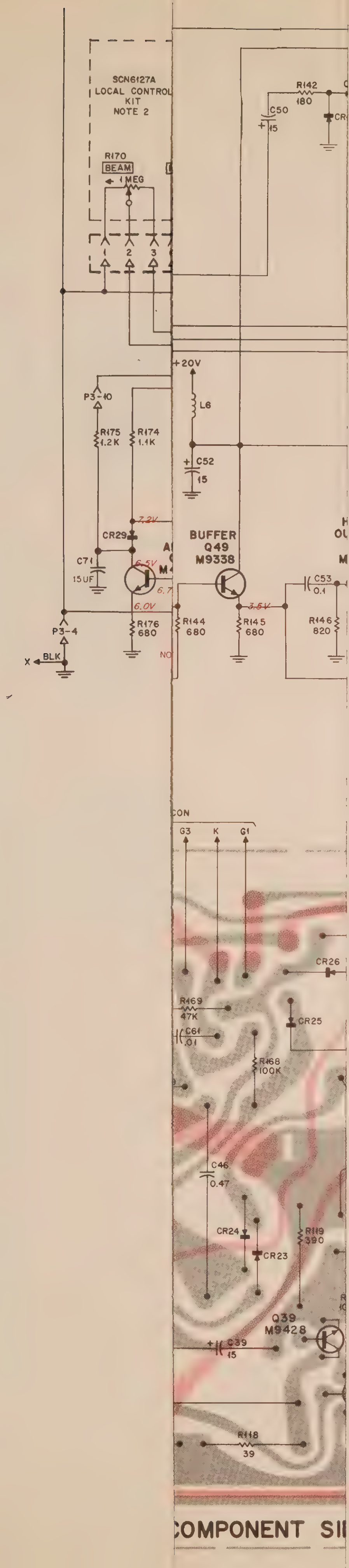
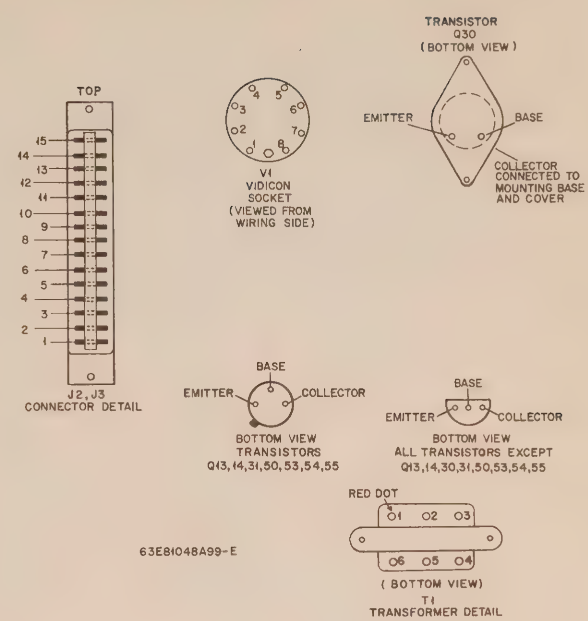
   C. P1 = VIDICON TARGET
   D. P4 = YOKE COILS. (MATES WITH J4)

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Video Amplifier, Model SLN6166A-4
Circuit Board Detail
Motorola No. EPD-19020-D
3/1/68-UP

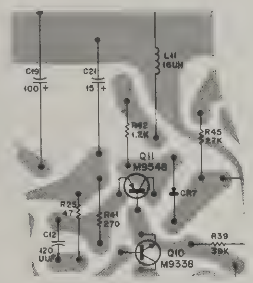
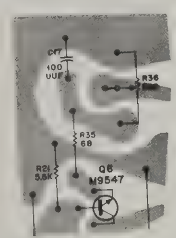




PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Supply and Deflection,
Model SLN6167A-4
Circuit Board Detail
Motorola No. EPD-19024-F
3/1/68-UP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	SLN6166A-1	C80	ADDED	Q18 BASE
		R1	WAS 6S129225, 10K	TOP RIGHT OF BOARD
B	SLN6166A-2	L10	WAS 24D82480B02 16 uh	Q11 COLLECTOR
		R42	WAS 6S129235, 1.2K	Q11 COLLECTOR
		R41	WAS 6S129752, 270	Q11 EMITTER
		R185	ADDED 4.7K	Q6 COLLECTOR
		R186	ADDED 1K	Q11 COLLECTOR
		R187	ADDED 10 OHMS	Q11 EMITTER
		C2	WAS 23D82601A15, 3 uf	TOP RIGHT OF BOARD
		C12	REMOVED 21K840713, 120 uuf	Q11 EMITTER
		R25	REMOVED 6S129233, 47 CIRCUIT WAS AS SHOWN BELOW	
				
		C17	REMOVED 21D82610C10, 100 uuf CIRCUIT WAS AS SHOWN BELOW	Q6 EMITTER
				
C	SLN6166A-3	C2	WAS 23D82601A16, 1 uf	TOP LEFT OF BOARD
		CR8	ADDED	TOP RIGHT OF BOARD
D	SLN6166A-4	R54	REMOVED WAS 6S129228 330K; ±10%; 1/4 W	TOP RIGHT OF BOARD
		R55	REMOVED WAS 6S129010 680K; ±10%; 1/4 W	
		CR8	REMOVED WAS 48D83461E16 ZENER DIODE; 91 V	TOP LEFT OF BOARD
		R97	ADDED	
		R188	WAS 6S129225 10K; ±10%; 1/4 W	TOP RIGHT OF BOARD

PARTS LIST

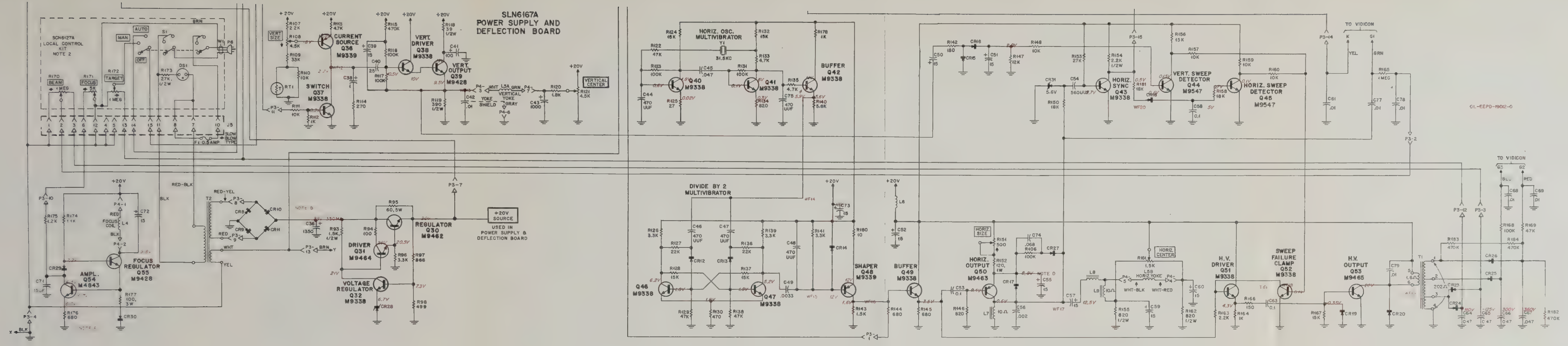
SLN6166A Video Amplifier Kit EPD-17222-D

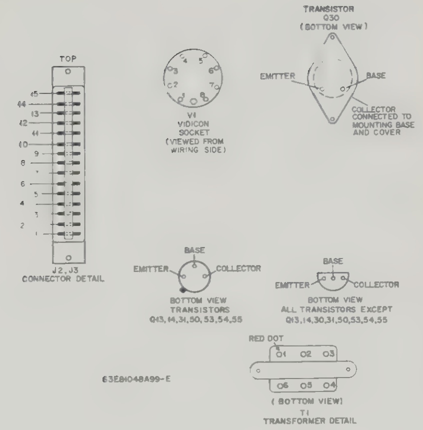
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf; ±10%; 100 v; unl stated
C1, 34	8K863508	.022 uf; 200 v
C2	23C82077C02	5 uf +100-15%; 150 v
C3, 5, 8, 9, 11, 13, 14, 21, 23, 25	23D83214C02	15 uf ±20%; 25 v
C4, 7, 10, 22	23D83214C17	3.3 uf ±20%; 15 v
C6	20K867490	var: 8-50
C19	23D82601A12	100 uf +150-10%; 6 v
C20, 32	8K857472	.047 uf; 200 v
C24	23C82077C16	400 uf +150-10%; 6 v
C26, 28	8D82905G04	.068 uf; 50 v
C29, 80	21K865452	680; 500 v
C30	21K840812	200 ±5%; 500 v
C31	8K857473	.01 uf; 200 v
C35	21K865922	390; 500 v
C70	23D82601A09	100 +150-10%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR2, 3, 6	48K863030	germanium
CR4, 5	48C82392B03	silicon
CR7	48D82420C05	silicon
CR8	48D83461E16	zener type: 91 v
		COIL, special purpose:
L1, 11	24D82480B02	16 uh; coded RED, YEL
L2, 3, 10	24D82480B04	25 uh; coded RED, BLU
		TRANSISTOR: (SEE NOTE)
Q1, 2, 5, 6	48R869547	N-P-N; type M9547
Q13, 14	48R134843	N-P-N; type M4843
Q3, 4, 10, 12, 15, 16, 18, 23, 24, 25, 26, 27, 28, 29	48R869338	N-P-N; type M9338
Q9, 11	48R869548	P-N-P; type M9548
Q17, 19, 20, 21, 22	48R869339	P-N-P; type M9339
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1	6S129227	270K
R2, 60	6S129662	180
R3, 59	6S129232	3.9K
R4, 30, 71, 185	6S127804	4.7K
R5, 9, 47, 95	6S128685	22K
R6, 11, 19	6S129753	100
R8, 17, 21, 63, 66, 73, 90	6S129433	5.6K
R12	6S129242	56K
R13, 15, 18	6S129235	1.2K
R14, 16, 20	6S129145	82K
R22	6S129775	330
R23, 24, 64, 78, 186	6S127802	1K
R26	18C82943G01	var: 4.5K ±20%; 2 w
R27, 38	6S129432	820
R28, 41	6S129617	120
R29, 46	6S129144	68K
R35	6S129861	68
R36	18C82943G02	var: 500 ±20%; 2 w
R37	6S127801	470
R39, 80	6S128903	39K
R42, 49	6S129620	560
R45	6S127806	27K
R48, 77, 82, 93	6S128689	2.2K
R50, 68	6S128687	6.8K
R51	6S6022	330; 1/2 w
R52	6S6373	150; 1/2 w
R53	6S5550	47; 1/2 w
R56	6S129013	1 meg
R57	6S128902	47K
R58	18C82943G09	var: 15K ±20%; 2 w
R61	6S129226	100K
R62, 70, 72, 75, 81, 83, 87, 94	6S129225	10K
R65, 85	6S127805	15K
R67	6S5551	120; 1/2 w
R69	6S128682	390K

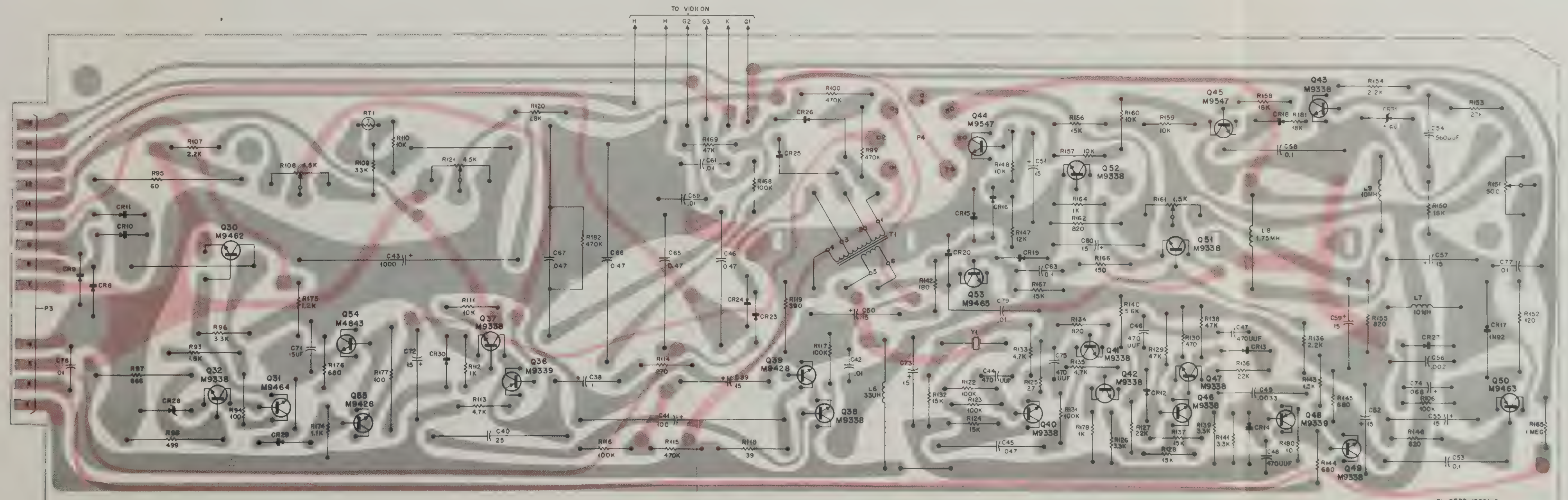
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R74	6S6229	1K; 1/2 w
R76	6S127803	1.5K
R79	6S128904	18K
R84	6S129224	82
R86	6S6269	820; 1/2 w
R88	6S129230	12K
R89	6S128599	680
R91	6S128686	8.2K
R92	6S128688	2.7K
R187	6S129755	10
R188	6S129147	220K

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



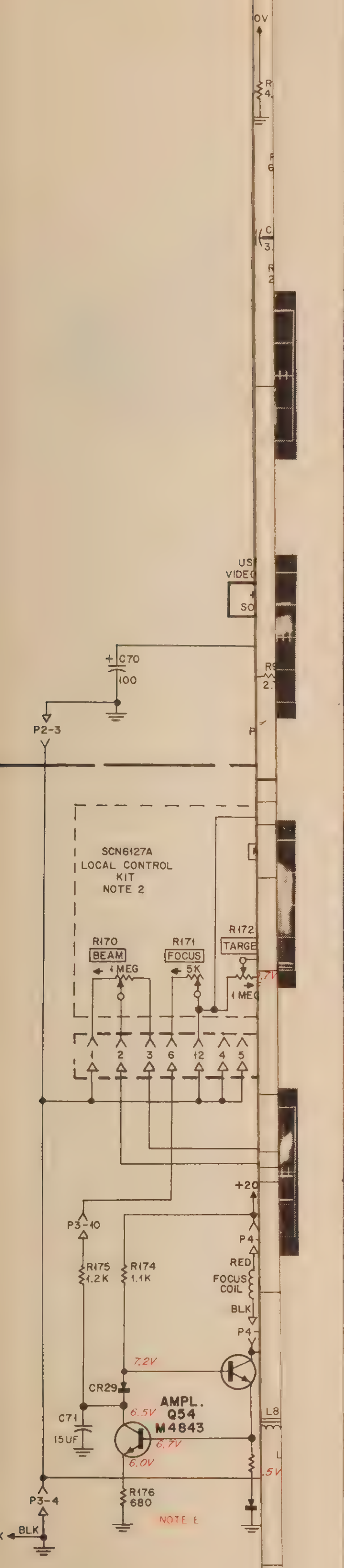


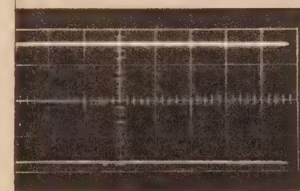


COMPONENT SIDE

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

Power Supply and Deflection,
Model SLN6167A-4
Circuit Board Detail
Motorola No. EPD-19024-F
3/1/68-UP

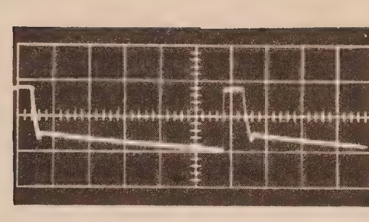




5V/DIV.

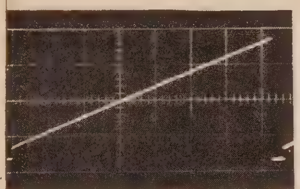
2 M SEC/DIV.

WF18



5V/DIV.

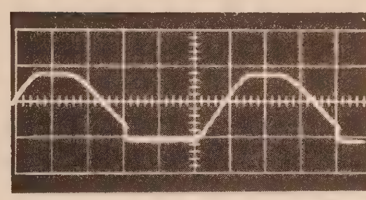
10 U SEC/DIV.



1V/DIV.

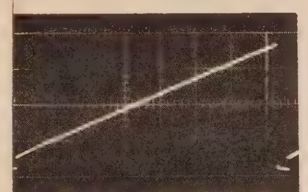
2 M SEC/DIV.

WF19



20V/DIV.

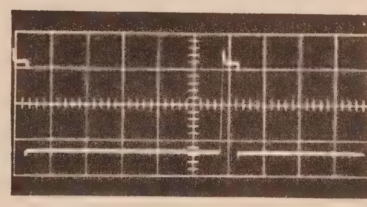
10 U SEC/DIV.



1V/DIV.

2 M SEC/DIV.

WF20



2V/DIV.

10 U SEC/DIV.

DEPD-19013-A

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
Motorola No. 63E81048A99-E
3/1/68-UP

REVISIONS

DIAG ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	SLN6167A		EXTENSIVE CIRCUIT AND COMPONENT CHANGES - START OF PRODUCTION	SCHEM. DIAG. & PARTS LIST
B	SLN6167A	CR12, 13	WERE 48C82420C01	PARTS LIST
		R122	WAS 6S129226, 100K	Q40 BASE
C	SLN6167A-1	C75	WAS 8C82187B08, 220 uuf	Q41 COLLECTOR
D	SLN6167A-2	CR25, 26	WERE 48C82466H26	PARTS LIST
E	SLN6167A-3	C68	WAS 21D82428B35 .01 uf; 500 V	PARTS LIST
F	SLN6174A-4	C71	WAS 21D82428B05; .01 +70-30%; 100 V	BOTTOM LEFT OF BD

PARTS LIST

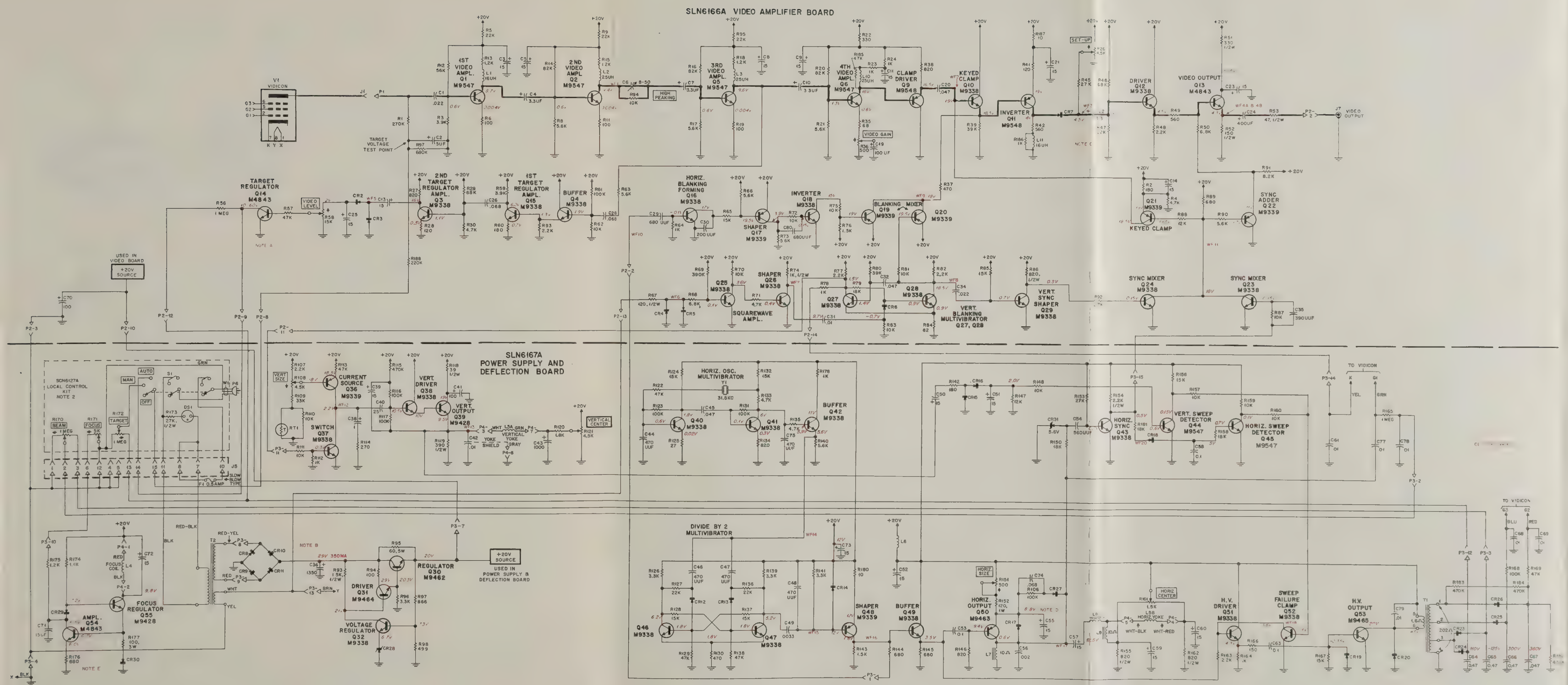
SLN6167A Power and Deflection Kit EPD-17223-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf; ±10%; 500 v; unl. stated
C36	23D82304B06	1350 +100-10%; 50 v
C38	23D82783B10	1 ±20%; 50 v
C39, 50, 51, 52, 55, 57, 59, 60, 72, 73	23D83214C02	15 ±20%; 25 v
C40	23C82645A03	25 +100-10%; 25 vnp
C41	23D82601A09	100 +150-10%; 25 v
C42	21D82428B05	.01 +70-30%; 100 v
C43	23C82077C04	1000; 15 v
C44, 46, 47, 48, 75	21C82187B07	470 uuf
C45	8K857472	.047; 200 v
C49	8K861939	.0033; 100 v
C53, 58	8K847099	0.1 ±20%; 150 v
C54	21D82187B06	560 uuf
C56	21D82187B24	.002
C61, 69, 77, 78	21D82428B35	.01 +80-20%
C63	8D82905G07	0.1; 50 v
C64, 65	8C82017C01	0.47; 200 v
C66	8C82317B05	0.47; 400 v
C67	8K865914	.047; 600 v
C68	21K801139	.01 +80-20%; 600 v
C71	23D83214C02	15; ±10%; 500 v
C74	8C82095G15	.068; 200 v
C79	8D82905G01	.01; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR8, 9, 10, 11, 31	48C82256H12	silicon
CR12, 13	48C82420C11	silicon
CR14, 15, 16	48K863030	germanium
CR17	48C82239F01	germanium
CR18, 29, 30	48C82392B03	silicon
CR19, 20	48C82420C01	silicon
CR21 thru 24	48C82466H17	silicon
CR25, 26	48C82372F01	silicon
CR27	48C82420C09	silicon
CR28	48D82256C47	silicon; zener type
		COIL, special purpose:
L6	24K854314	33 uh
L7, 9	25B82719A02	10 mh
L8	25C82003F01	1.75 mh
		TRANSISTOR: (SEE NOTE)
Q30	48R869462	N-P-N; type M9462
Q31	48R869464	N-P-N; type M9464
Q32, 37, 38, 40, 41, 42, 43, 46, 47, 49, 51, 52	48R869338	N-P-N; type M9338
Q36, 48	48R869339	P-N-P; type M9339
Q39, 55	48R869428	N-P-N; type M9428
Q50	48R869463	P-N-P; type M9463
Q53	48R869465	N-P-N; type M9465
Q54	48R134843	N-P-N; type M4843
Q44, 45	48R869547	N-P-N; type M9547
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R93	6S6038	1.5K; 1/2 w
R94	6S129753	100
R95	17C82291B30	60; 5 w
R96, 126, 139, 141	6S129231	3.3K
R97	6D82672B51	866 ±1%; 1/2 w
R98	6D82672B50	499 ±1%; 1/2 w
R106, 116, 117, 123 131, 168	6S129226	100K
R107, 163	6S128689	2.2K
R108, 121	18C82943G01	var; 4.5K ±20%; 2 w
R109	6S127807	33K
R110, 111, 148, 157, 159, 160	6S127225	10K
R112, 164, 178	6S127802	1K
R113, 133, 135	6S127804	4.7K

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R114	6S129752	270
R115	6S129148	470K
R118	6S2085	39; 1/2 w
R119	6S5554	390; 1/2 w
R120	6S129269	1.8K
R122, 129, 138, 169	6S128902	47K
R124, 128, 132, 137, 156, 167	6S127805	15K
R125	6S131594	27
R127, 136	6S128685	22K
R130	6S127801	470
R134, 146	6S129432	820
R140	6S129433	5.6K
R142	6S129662	180
R143	6S127803	1.5K
R144, 145, 176	6S128599	680
R147	6S129230	12K
R150, 158, 181	6S128904	18K
R151	18C82943G02	var; 500 ±20%; 2 w
R152	6S488021	120; 1 w
R153	6S129886	27K ±5%
R154	6S6069	2.2K; 1/2 w
R155, 162	6S6269	820; 1/2 w
R161	18C82943G06	var: 1.5K ±20%; 2 w
R165	6S129013	1 meg
R166	6S129862	150
R174	6S124A50	1.1K ±5%
R175	6S129708	1.2K
R177	17C82291B21	100 ±5%; 3 w
R180	6S129755	10
R182, 183, 184	6S6377	470K; 1/2 w
		THERMISTOR, rod:
RT1	6B82005F01	13.8K @25°C
		TRANSFORMER,
T1	25C82004F01	high voltage
		CRYSTAL UNIT; quartz:
Y1	48C82020F01	31.5 kc
NON-REFERENCED ITEMS		
	9C857351	SOCKET, printed circuit (7 pin)
	1V80795A14	SOCKET ASSEMBLY (vidicon)

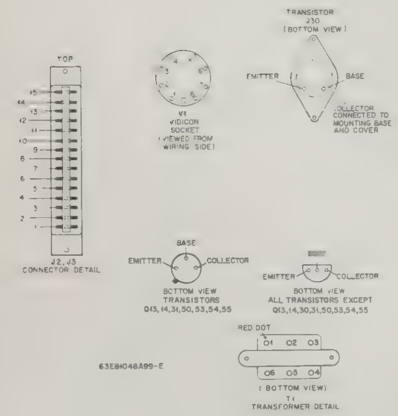
NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



NOTES

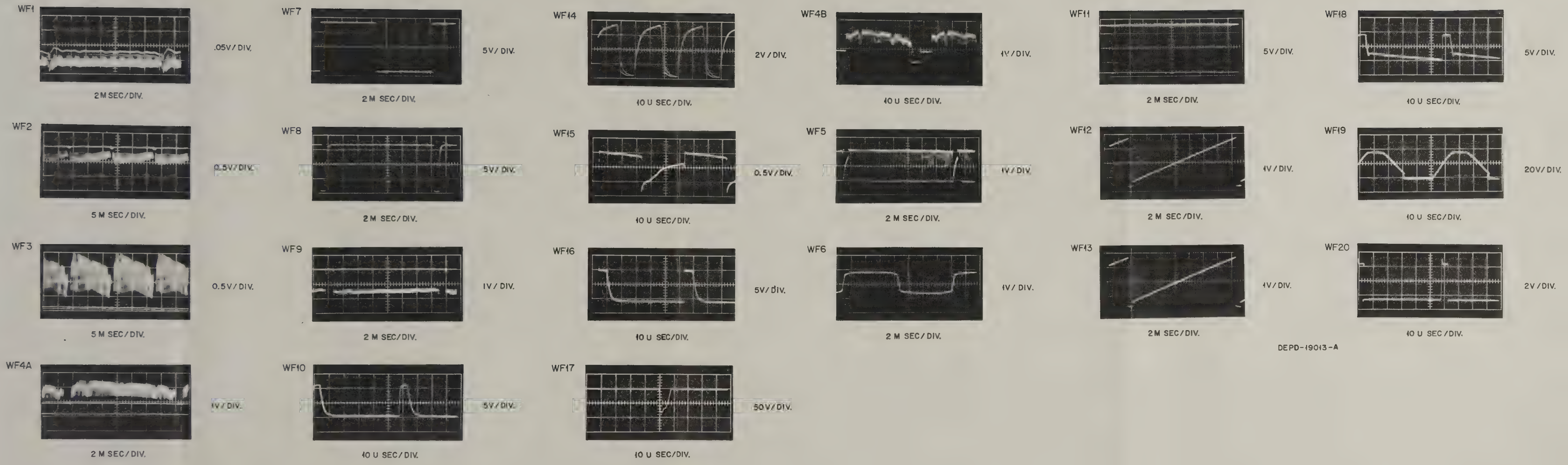
1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. COMPONENTS LOCATED ON LOCAL OR REMOTE CONTROL UNIT
3. DIRECTION ARROWS ON CONTROLS DENOTE CLOCKWISE ROTATION
4. EXPLANATION OF CIRCUIT BOARD EDGE-CONNECTIONS
   A. P2 = VIDEO AMPLIFIER BOARD (MATES WITH J2).
   B. P3 = POWER SUPPLY AND DEFLECTION BOARD (MATES WITH J3
   C. P1 = VIDICON TARGET
   D. P4 = YOKE COILS. (MATES WITH J4)



63E81048A95-E

VOLTAGE NOTES:

A. VOLTAGE DEPENDS ON VIDEO LEVEL SETTING
B. VOLTAGE DEPENDS ON LINE VOLTAGE
C. VOLTAGE DEPENDS ON SET-UP SETTING
D. VOLTAGE DEPENDS ON WIDTH SETTING
E. VOLTAGE DEPENDS ON FOCUS SETTING



PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

Schematic Diagram
Motorola No. 63E81048A99-E
3/1/68-UP

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	SLN6167A-1		EXTENSIVE CIRCUIT AND COMPONENT CHANGES - START OF PRODUCTION	SCHEM. DIAG. & PARTS LIST	PWR. SUP. & DEFL. BD. EPD-19024-A
	SLN6166A-1				VIDEO AMP BD. EPD-19020-A
B	SLN6167A-1				PWR. SUP. & DEFL. KIT EPD-19024-B
	SLN6167A-2				PWR. SUP. & DEFL. KIT EPD-19024-C
B1	SLN6167A-2				PWR. SUP & DEFL. KIT EPD-19024-D
C	SLN6166A-2				VIDEO AMPL. BOARD EPD-19020-B
D	SLN6166A-3				VIDEO AMPL. BOARD EPD-19020-C
E	SLN6166A-4				VIDEO AMP BD EPD-19020-D
	SLN6167A-4				PWR SUPPLY & DEFL BD EPD-19024-F

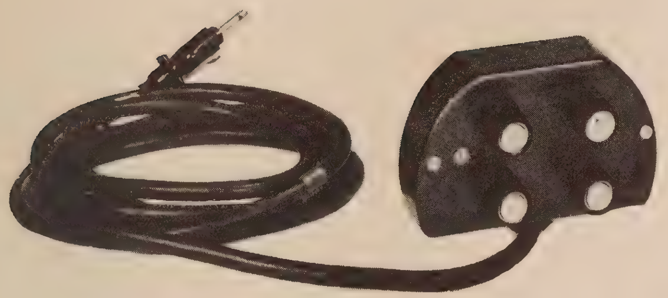
PARTS LIST

SHN6120A Housing Kit EPD-17247-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		FUSE, cartridge: 1-1/4" x 1/4"
F1	65K475395	slow-blow type; 0.5 a; 125 v
		CONNECTOR, receptacle:
J2, 3	9C82492E03	female; 15 cont.
J7	9C82442E07	female; coaxial; uhf type
		COIL, electron beam focusing:
L4	24D82291D01	630 uh; res 175 ohms ±10%
		COIL ASSEMBLY, deflection:
L5	24D82291D03	c/o:
L5A		(vertical); 50 uh; res 200 ohms ±10%
L5B		(horizontal); 1 uh; res 3.8 ohms ±10%
		CONNECTOR, plug:
P4	28B82332D01	male; 7 cont; does not incl. 15A82181D01 COVER (rubber)
P5	28C82019F01	male; 15 cont.
		TRANSFORMER, power: 117v ac 50/60 cps;
T2	25C82018F01	pri: BLK, BLK-RED: res 19.7 ohms ±10% sec: No. 1: RED, RED-YEL: res 1.68 ohms ±10% sec. No. 2: WHT, YEL; res 1.2 ohms ±10%
		ELECTRON TUBE:
V1	65B82292D01	vidicon; type 7735A

CAMERA LOCAL CONTROL KIT

MODEL SCN6127A



1. DESCRIPTION

The local control kit is used with the Motorola Transistorized Television Camera Model S1140A. The Model SCN6127A Local Control Kit is mounted on the rear of the camera. The Model SLN6172A Junction Unit is used to connect the camera to remote controls.

The camera control kit provides four control facilities for operation of the camera. They are as follows:

a. The OFF-MAN-AUTO switch applies 117 vac, 60 cycle line voltage to the camera, and selects the mode of vidicon target voltage adjustment (sensitivity). In the AUTOmatic position, target voltage is automatically adjusted by camera circuits. In the MANual position, target voltage is manually adjusted by the TARGET control.

b. The FOCUS control adjusts the magnetic focus of the camera vidicon tube.

c. The BEAM control adjusts the camera vidicon tube beam current.

d. The TARGET control adjusts the vidicon target voltage when the AUTOmatic MANual switch is in the MANual position. Refer to the TRANSISTORIZED CAMERAS section of this instruction manual for the proper setting of these controls.

2. INSTALLATION

a. Model SCN6127A Local Control Kit

Screw the two threaded studs supplied with the control kit into the two tapped holes on the rear of the camera. Fit the control kit to the rear of the television camera so that the control kit jack mates with the camera plug. Secure in position with hardware provided. Insert the power plug into a 117 v ac 60 cycle receptacle.

Connect the camera video output, from the UHF connector on the rear of the camera, to the VIDEO INPUT UHF connector on the rear of the monitor. Use connectors and coaxial cables described in the TRANSISTORIZED CAMERAS section, INSTALLATION paragraph of this manual.

b. Model SLN6172A Junction Unit

The following procedure should be followed for connecting the control cable to the SLN6172A Junction Unit and installing the junction unit on the camera:

(1) Strip the cable jacket back about three inches and add spade lugs on the ends of the wires.

NOTE

If the camera is used in an outdoor or explosion-proof housing, Step 2 must be followed. When used without an additional housing, disregard Step 2 and proceed to Step 3.

(2) Pass the cable through the sealed cable clamp on the back of the housing. Refer to Figure 1.

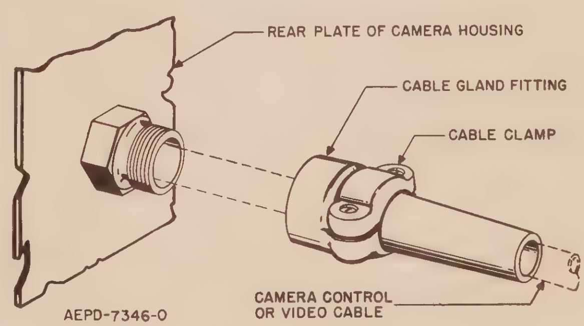


Figure 1.
Cable Gland Fitting Detail

(3) Attach the rectangular cable clamp to the control cable. On smaller diameter cables it will be necessary to slip the neoprene sleeve over the cable to permit the clamp to grip the cable properly. Refer to Figure 2.

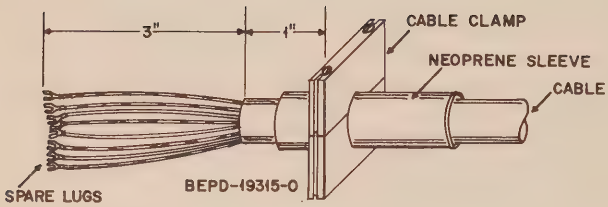


Figure 2.
Neoprene Sleeve and Cable Clamp
Installation Detail

(4) Attach the wires to the appropriate terminals of the terminal board.

(5) Attach a lead from the zoom lens together with a lead from the control cable together under one terminal screw.

(6) Screw the two short studs into the tapped holes on the back of the camera.

(7) Plug the connector of the junction unit into the camera, and with the two long threaded studs provided, fasten it to the camera.

(8) Place cover in position and fasten with its screws. When placing the cover in position, slide the cable clamp into the notch provided in the cover. See Figure 3.

For removal, follow the installation procedure in reverse order. In those cases where it is only necessary to remove the camera, the wires do not have to be removed. The following procedure should be followed.

(1) Remove cover by removing the two screws holding it to the rear of the camera.

(2) Remove the two long threaded studs holding the terminal board to the back of the camera, and unplug the terminal board from the camera.

(3) Remove zoom lens from the camera.

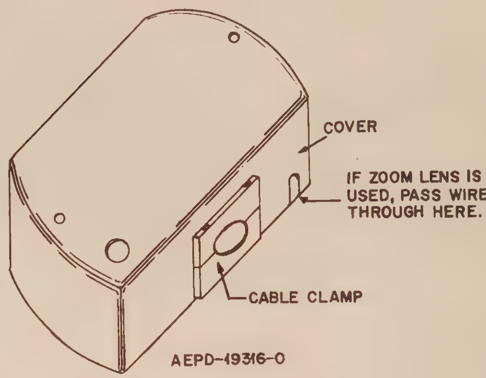


Figure 3.
Cable Entrance in Cover Detail

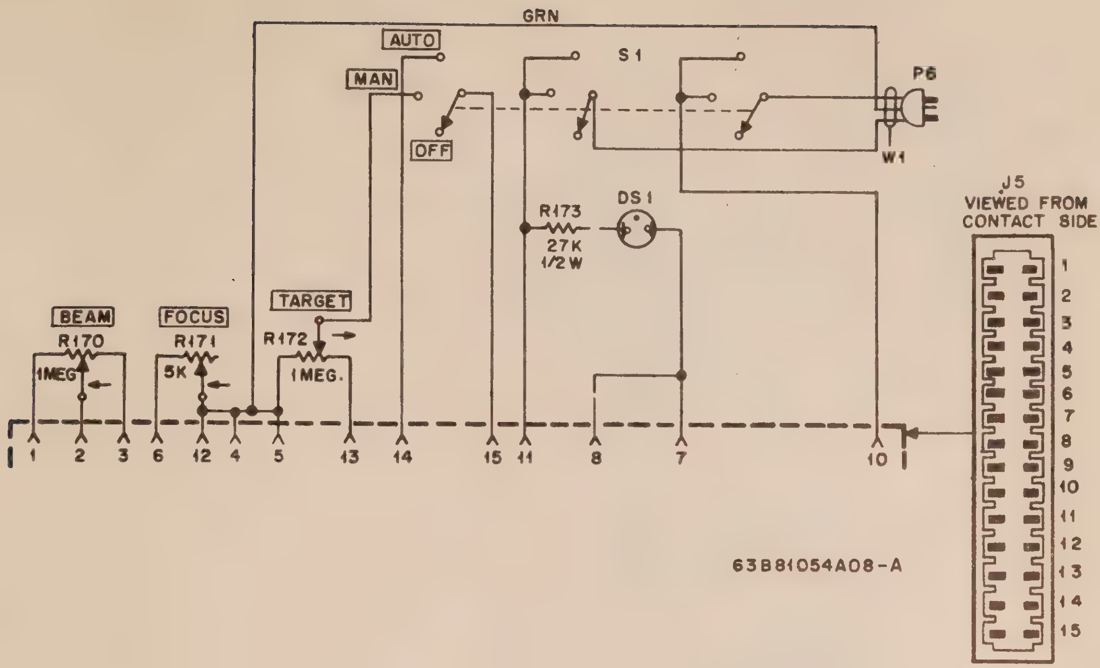
3. MAINTENANCE

Maintenance of these control facilities consists of keeping the unit clean and connections tight.

Malfunction of the control facilities can normally be attributed to lack of power. Use the schematic diagrams in this instruction section to locate the circuits at fault. In most instances, troubles can be isolated by using only a voltmeter.

4. DATA INCLUDED

Local Control Kit Schematic Diagram	63B81054A08
Junction Unit Schematic Diagram	63A81054A07



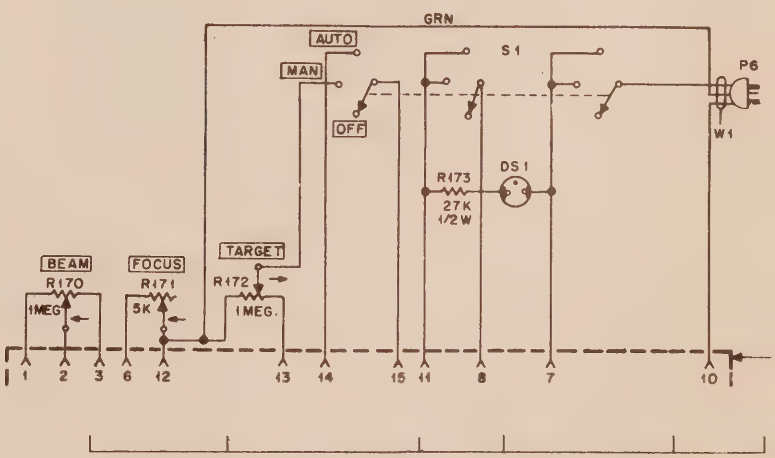
PARTS LIST

SCN6127A Local Control Kit EPD-17221-O

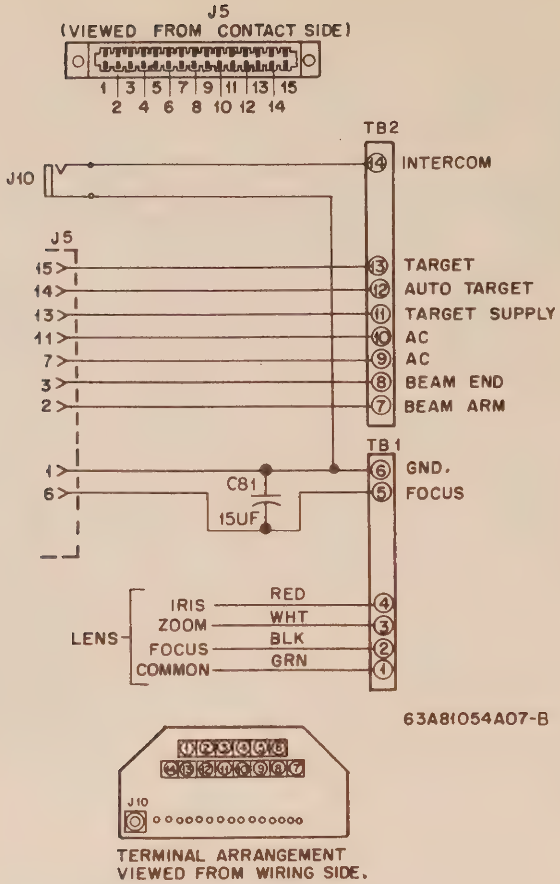
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
DS1	65K868606	LAMP, glow: neon; type NE2H
J5	9C82492E03	CONNECTOR, receptacle: female; 15 cont.
P6		CONNECTOR, plug: (p/o W1)
R170, 172 R171	18C82017F02 18C82017F01	RESISTOR, variable: 1 meg ±30%; 0.2 w 5K ±30%; 0.25 w
R173	6S6434	RESISTOR, fixed: 27K ±10%; 1/2 w
S1	40C82086F01	SWITCH, rotary: 3 pole; 3 position
W1	30C865903	CABLE ASSY, power: 3 cond; each cond. No. 18 ga. str. incl. a "molded-on" 3 cont. male plug (P6); length 8 ft. overall

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	SCN6127A-1		CIRCUIT WAS AS SHOWN BELOW	



Model SCN6127A Local Control Kit
Schematic Diagram
Motorola No. 63B81054A08-A
3/1/68-UP



REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	SLN6172A-1	C81	ADDED	BETWEEN TERMINALS 5 AND 6 OF TB1
B	SLN6172A-1		PIN 7 ON J5 WAS PIN 10	BETWEEN TERMINALS 3 & 11

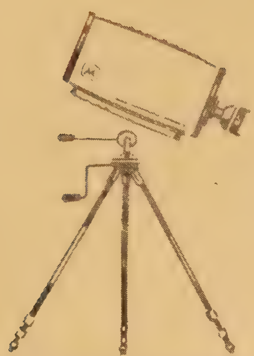
PARTS LIST

SLN6172A Junction Unit EPD-19411-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C81	23D83214C02	15 uf; ±20%; 25 v
		CONNECTOR, receptacle:
J5	9C82492E03	female; 15 cont.
		JACK, telephone:
J10	9B82166F01	single circuit
		TERMINAL BOARD:
TB1	29B82163F01	6 screw terminals
TB2	29B82163F02	8 screw terminals
	NON-REFERENCED ITEMS	
	15D82021F03	COVER
	46A82164F01	STUD (short): 2 req'd.
	46A82010F01	STUD (long): 2 req'd.
	37B82167F01	SLEEVE
	42B82165F01	CLAMP, cable
	3S136057	SCREW, machine: 4-40 x 3/4" slotted flat head; 2 req'd.

Model SLN6172A Junction Unit
Schematic Diagram
Motorola No. 63A81054A07-B
3/1/68-UP

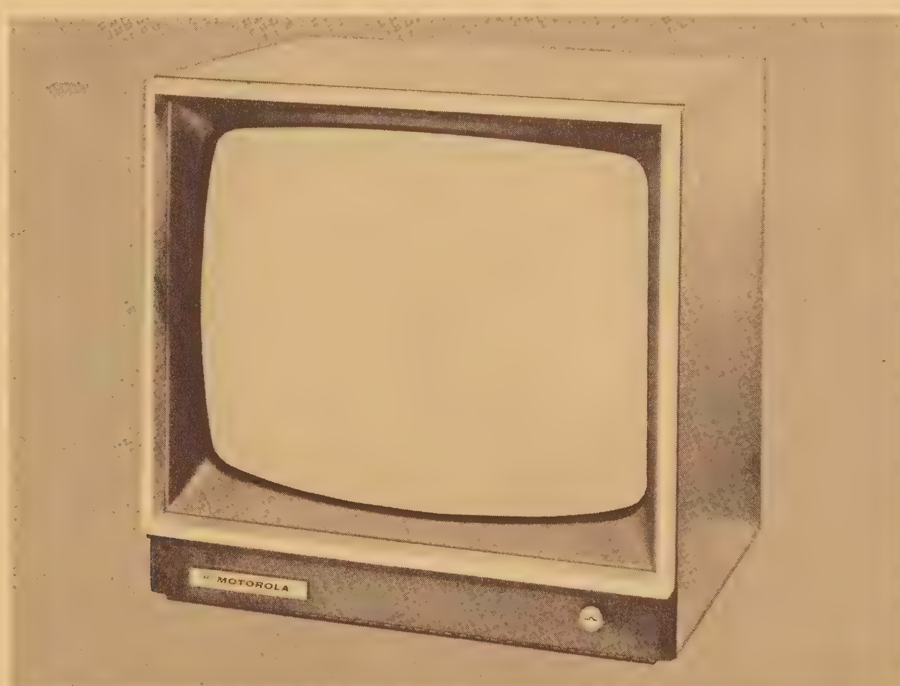
MOTOROLA INC. COMMUNICATIONS DIVISION • **INSTRUCTION MANUAL**



CCTV

MOTOROLA *closed circuit television*

19" Video Monitor



68P81039A25-C

MOTOROLA

CLOSED CIRCUIT TELEVISION

19" VIDEO MONITOR

MODEL S1219A

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

5/7/68-UP

68P81039A25
Issue - C

CONTENTS

ACCESSORY ITEMS

DESCRIPTION

1. GENERAL

The Motorola industrial closed circuit video monitor is a transistorized high quality, 19-inch picture display unit designed for the exacting requirements of industrial applications. It incorporates the features of extra brightness, high contrast, increased resolution, long term stability, and long operating life, all of which are necessary for a successful industrial application. This monitor has the advantages of solid-state circuits---reliability, compactness ruggedness low current demands, and low maintenance requirements.

The Motorola monitor is used in a cable-type, "closed circuit" camera system to display video from a remotely located television camera. With its increased resolution, it is capable of displaying the fine detail transmitted by the camera. Its long term stability permits it to be operated continuously for long periods without readjusting the controls. Long operating life keeps maintenance costs and service interruptions to a minimum.

2. MODEL COMPLEMENT

The Model S1219A 19-inch Video Monitor consists of the following items:

Item	Description
SCN6125A	Monitor Control Panel
SHN6118A	Monitor Housing
SLN6146A	Back Panel
SLN6148A	Video Amplifier & Deflection Kit
SLN6163A	Horizontal Output Kit

3. OPTIONAL ACCESSORIES

In addition to the basic items listed in the MODEL COMPLEMENT, three optional accessories are available which must be ordered separately.

Item	Description
SCN6124A	Camera Control Panel
SLN6149A	Monitor Rack-Mount Adapter
SLN6162A	Monitor Polarized Glass

INSTALLATION

1. INSTALLATION CONSIDERATIONS

The video monitor can be placed in any convenient location. Although the monitor has enough brightness to permit operation in locations of relatively high light level, it is best to keep the surrounding light as low as possible.

In those locations where annoying glare or reflections are present, the SLN6162A Monitor Polarized Glass may be used. This will considerably reduce the glare and reflections.

For viewing by large groups, several monitors may be connected to the video line without decreasing the picture quality.

When installing the monitor, consideration must be given to select a location which will permit adequate ventilation for cooling of the unit. For this reason, locations near radiators, hot pipes, or enclosed niches should be avoided.

Electrical power for the monitor is obtained from a 117-volt, 60 cycle a-c source. The monitor line cord has a three-prong plug, the third prong being the ground connection. When using an adapter which permits plugging into a conventional outlet, the wire protruding from the adapter must be grounded. In most cases this can be accomplished by connecting it to the outlet box. However, if the outlet box is not grounded, another ground must be used.

WARNING

> Very high voltages are generated in the video monitor. Death on contact can result. Be extremely careful when working on the unit.

This Motorola video monitor operates with a composite video signal since in most industrial applications a composite video signal is used. The synchronizing information is combined with the video signal and only one cable is required for transmitting both video and synchronizing information.

The video information from the television camera is transmitted to the monitor by coaxial

cable. This cable is connected to the coaxial receptacle marked VIDEO INPUT at the rear of the monitor. Notice in figure 1 that two such receptacles are provided. The coaxial receptacles are wired in parallel. Either receptacle may be used for the video input, and the other used for extending the coaxial line to other monitors included in the system. This arrangement allows many monitors to be "looped" through a cable run, rather than having an individual cable extending from the camera to each monitor.

2. INSTALLATION PROCEDURE

a. Power

(1) Connect line cord to a 117-volt, 60 cycle a-c source.

(2) Make certain ground wire is grounded if adapter is used.

b. Video

(1) Connect video feed cable to one of the VIDEO INPUT connectors.

(2) If a video feed to another monitor is desired, connect second monitor to unused VIDEO INPUT connector.

(3) All monitors in parallel have the termination (TERM) switch in "OUT" position, with the exception of the last monitor whose termination (TERM) switch must be in the "IN" position.

(4) When a ground current interfering signal (indicated by sync instability or hum bars) is present on the monitor, place the differential (DIFF) switch in the "IN" position.

(5) Set d-c restoration (DC R) switch as follows:

(a) For single camera presentations, place in "IN" position.

(b) For multiple camera presentations, where separate balanced video amplifiers are not used, place in "OUT" position to maintain overall picture intensity at a constant level from camera to camera.

(6) In systems with video cable runs over 1500 feet, horizontal resolution will be reduced due to high-frequency "roll-off" characteristics of the video cable. This monitor has a network to compensate for cable runs from 2000 feet to 8000 feet, in increments of 1000 feet. The monitor is shipped with the network adjusted for cable runs up to 1500 feet in length. For greater lengths, the network should be adjusted by moving a jumper plug (P2) on the printed circuit board. Each position has a tolerance of ±500 feet. For cable runs of 2000 feet and over, insert jumper plug P2 to the following position:

CABLE RUN (in feet)	POSITION
2000	A
3000	B
4000	C
5000	D
6000	E
7000	F
8000	G

OPERATING INSTRUCTIONS

1. GENERAL

Operation of the Motorola video monitor is quite simple, requiring the adjustment of only four controls to obtain a good picutre. The operating controls are divided into two groups, primary and secondary. The primary operating controls are BRIGHTNESS, horizontal hold (H HOLD), vertical hold (V HOLD), and CONTRAST. The secondary operating controls are B+ adjust (B+ ADJ) vertical linearity (VERT LIN), and HEIGHT. The secondary controls are pre-set at the factory and should not need any adjustment. However, if any need for adjustment should arise, refer to the MAINTENANCE AND ADJUSTMENTS section of this manual.

2. ADJUSTING MONITOR

a. Turn monitor ON. Allow about two minutes for the unit to warm up.

b. Turn the primary operating controls, BRIGHTNESS, horizontal hold (H HOLD), vertical hold (V HOLD), and CONTRAST to their mid-range position.

c. If the picture is rolling vertically, adjust the vertical hold (V HOLD) control.

d. If the picture tears horizontally, adjust the horizontal hold (H HOLD) control.

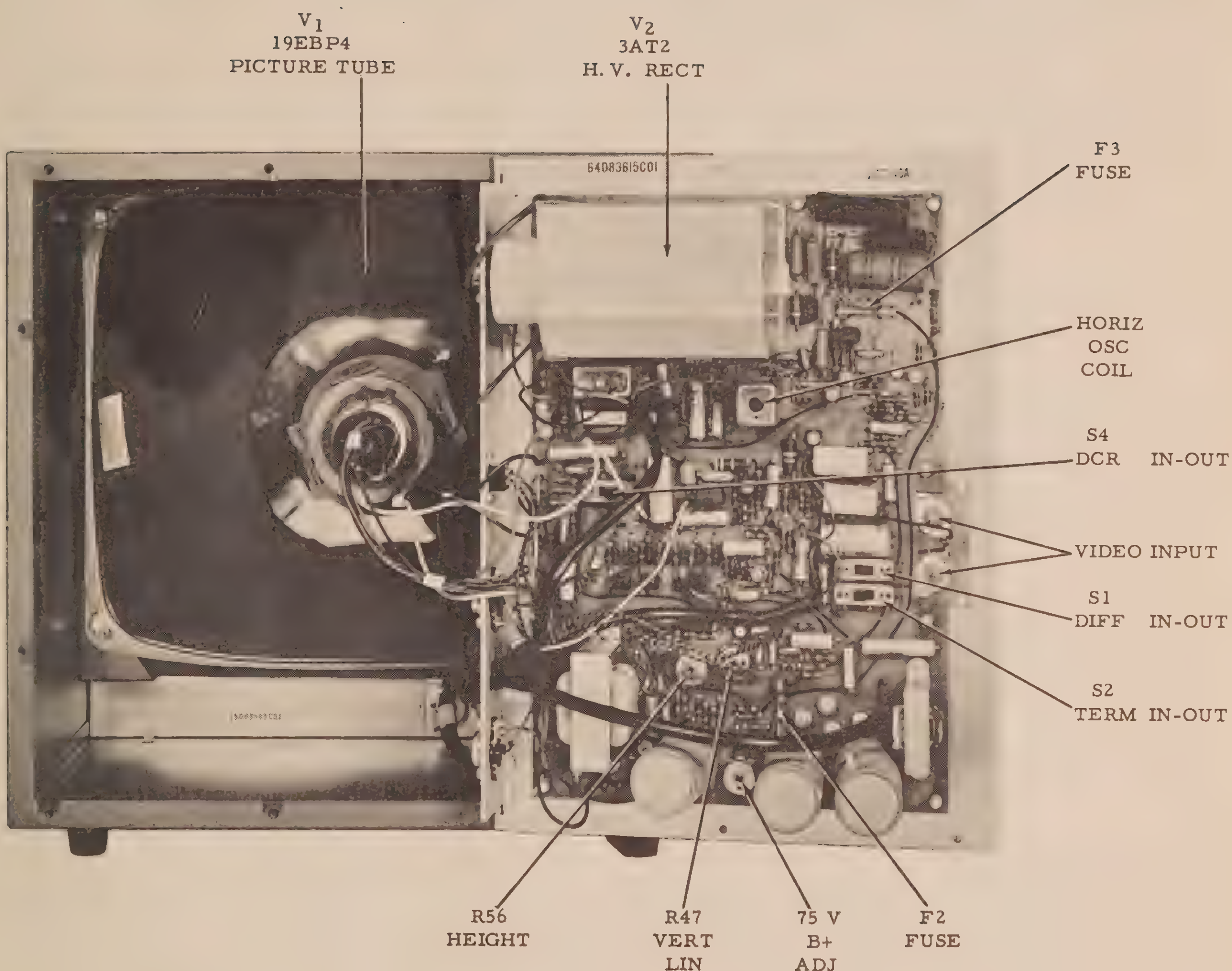


Figure 1.
Monitor Chassis Layout with
Model SCN6124A Camera Control Panel

e. Turn the CONTRAST control to the extreme counterclockwise position.

f. Adjust the BRIGHTNESS control until the raster is barely visible under ambient lighting.

g. Turn the CONTRAST control to the extreme clockwise position, then back off about ten degrees.

h. Adjust BRIGHTNESS and CONTRAST controls for best picture.

i. The monitor need not be adjusted each time it is turned on, as it is quite stable, and will generally operate well after normal warm-up.

3. CORRECTIVE ACTION IF MONITOR SHOWS NO PICTURE DISPLAY

a. Check all cables to see that they are properly connected.

b. Make certain television camera is turned on.

c. If monitor still does not show a picture, refer to MAINTENANCE AND ADJUSTMENTS section.

THEORY OF OPERATION

1. BLOCK DIAGRAM DESCRIPTION
(See Figure 2)

The incoming composite video is applied to the differential video amplifier Q1. The video signal is amplified by Q1 and fed to buffer amplifier Q2. The signal is then fed to Q3 which is a controlled degeneration amplifier that compensates for roll-off characteristics of long coaxial cable runs.

NOTE

Seven different networks are provided to compensate for different coaxial cable lengths.

From here, the signal is fed to the video output driver stage Q4 and to the video output stage Q5. Finally, the signal is coupled to the picture tube V1.

A 60-cycle saw-tooth is generated by the vertical oscillator and, after receiving one stage of amplification, is applied to the vertical deflection yoke. The vertical oscillator is a free-running oscillator which is triggered by the vertical sync pulses.

Horizontal oscillator Q14 generates a 15,750-cycle square wave voltage. This voltage is applied to the horizontal pre-driver Q15. The pre-driver Q15 is directly coupled to the horizontal driver stage Q16 which is transformer coupled to the horizontal output transistor Q17, which amplifies the signal and applies it to the deflection yoke. High d-c voltage is obtained from high voltage rectifier V2 and applied to the picture tube. In order to maintain the horizontal frequency, pulses are taken from the horizontal amplifier and compared with horizontal sync pulses in the afc circuit. Any difference in phase between the pulses results in a d-c control voltage which is applied to the horizontal oscillator, causing it to change to the correct frequency.

2. DETAILED CIRCUIT ANALYSIS

a. Differential Video Amplifier and Associated Stages

When differential (DIFF) switch S1 is placed in the OUT position, the coaxial input shield is connected directly to chassis ground. Under this condition, Q1 operates as a normal video amplifier.

In some installations, there is an a-c potential present between the camera and monitor ground points. This potential is usually only a few volts, but it can cause very high currents to flow in the coaxial shield connecting the camera and monitor. When differential (DIFF) switch S1 is placed in the IN position, the ground loop problem is reduced by placing the relatively high resistance R3 between the coaxial shield and ground. The interfering signal then appears in phase and equal amplitude on the base and emitter of Q1. In this mode, Q1 responds only to differences in voltage between the shield and center conductor of the input cable and not to potentials between the shield and ground. An interfering signal appearing from the coaxial shield to ground is effectively made part of the collector voltage supply to Q1. Since the collector current of Q1 is independent of the collector voltage and the output is derived from collector current, interfering signals do not appear in the output.

The desired signal always appears between the shield and center conductor of the input cable.

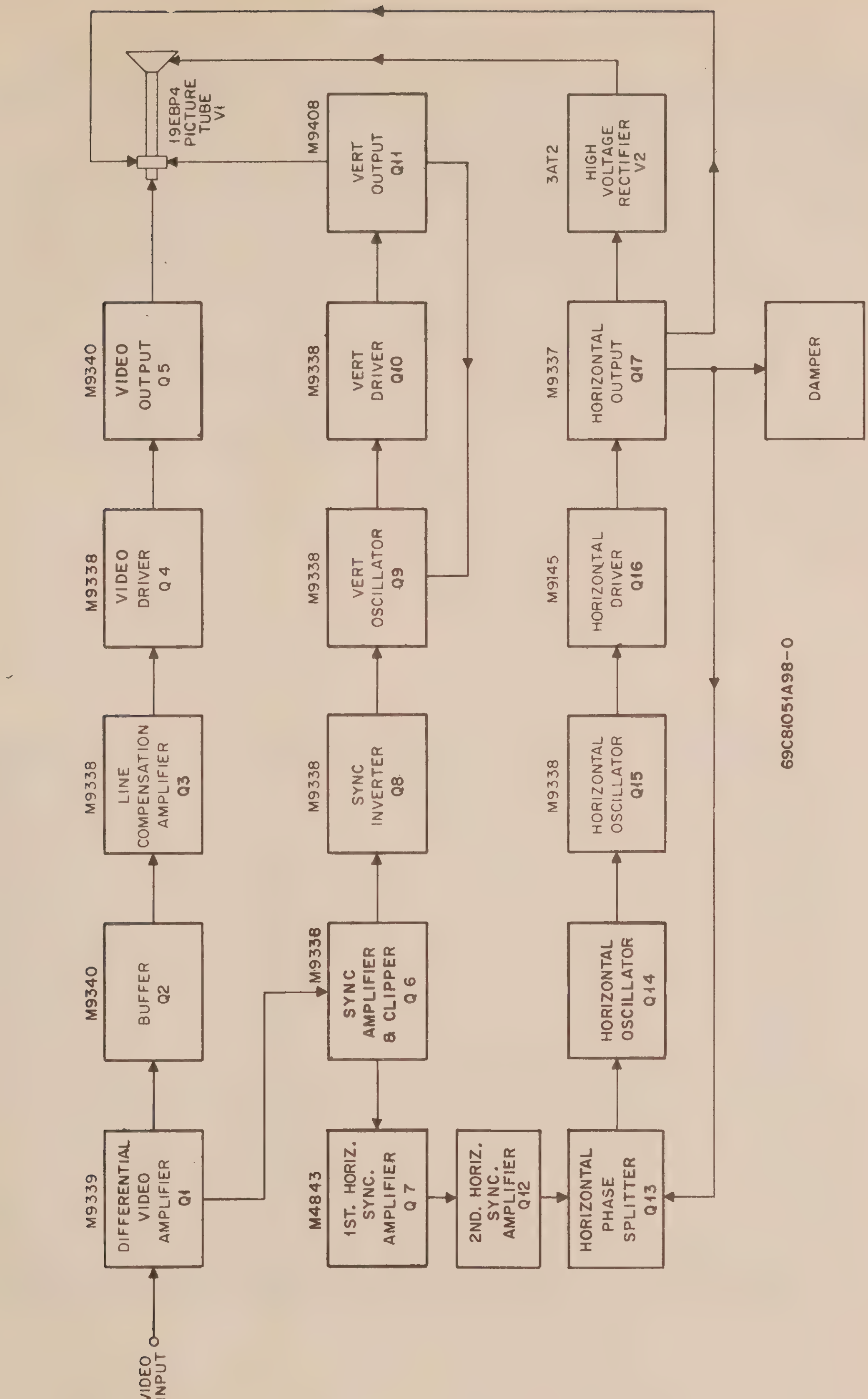


Figure 2.
Monitor Block Diagram

At 60 cycles, Q1 exhibits about 60 db greater amplification for a signal applied from the center conductor to the shield than it does for the same signal applied from the shield to ground. The shield-to-ground signal amplitude may be as great as 12 volts peak-to-peak. The output of Q1 is coupled to Q6 and to Q2. Stage Q2 is an emitter follower and the output is directly coupled to Q3. Stage Q3 has controlled degeneration in the emitter circuit to compensate for long runs of coaxial cable. The output of Q3 is coupled to an emitter follower, Q2. Stage Q5 is a series-shunt peaked stage that drives picture tube V1. Diode CR1 provides d-c restoration to the cathode of the picture tube.

b. Horizontal Sync Circuitry

Capacitor C13 couples the composite video signal to diode clipper CR2; the output of the diode clipper is directly coupled to the base of Q6, the sync amplifier. With normal input signal, Q6 will saturate and cut off on the sync signal. The output at the collector of Q6 is directly coupled through R38 to the base of Q7, the first horizontal sync amplifier. The sync signal at the base of Q7 is sufficient to drive the stage into cutoff and saturation. The diode (CR3) prevents excessive base-to-emitter reverse bias on Q7 when the stage is cut off. The output at the collector of Q7 is coupled through C15 to the base of Q12, the second horizontal sync amplifier. Q12 acts as a current amplifier to provide sufficient base current drive to the horizontal phase splitter, Q13. Q13 has two outputs which are 180° out of phase. These outputs are coupled to the afc bridge consisting of CR4, CR5, R66 and R67 through capacitors C26 and C25. The afc bridge and associated components comprise the afc circuit of the horizontal oscillator.

The afc circuit compares the phase of a feedback pulse from the horizontal amplifier circuit to the phase of a horizontal sync pulse. A d-c correction voltage proportional to the phase difference between the two pulses is developed, filtered and applied to the horizontal oscillator. Thus any deviation of the horizontal oscillator frequency from the sync rate is opposed by the application of the correction voltage to the horizontal oscillator.

c. Vertical Sync Circuitry

The negative sync pulses at the connector of Q6 are direct coupled to the base of Q8, the sync inverter. The positive-going pulses at the collector of Q8 are applied to the vertical integrating circuit comprised of R43 and C16 and applied to the base of Q9, the vertical oscillator.

d. Vertical Deflection System

The vertical deflection system consists of a three-stage, free-running, symmetrical multivibrator using Q9, the vertical oscillator, Q10, the driver and Q11, the output stage.

When Q9 is cut off, C20 and C21 charge through R49 at an exponential rate. This fires Q9 and discharges C20 and C21 to form a sawtooth signal. This signal is applied to the base of Q10, an emitter follower, which in turn drives the base of output transistor Q11.

As Q11 draws current, a voltage corresponding to the base waveform is developed across R55 and R56. This voltage is applied through a resistive network to the junction of C20 and C21. The amount of feedback is controlled by R47, the linearity control and, when properly adjusted, cancels out the forward non-linearity.

The HEIGHT control, R56, adjusts the gain of the output stage.

To sustain oscillation, part of the vertical retrace pulse is fed back to the base of Q9, after proper shaping by R57, C22 and R54. The vertical free-running frequency is adjusted by the RC time constant of R46, C20 and C24.

e. Horizontal Defection System

The horizontal oscillator (Q14) is a modified Colpitts type. The free-running frequency is determined by L5, C30, C31 and C32. The pulses at the collector of Q14 are coupled to the base of Q15, the horizontal pre-driver. The output at the collector of Q15 is directly coupled through the pulse shaping network consisting of L6, R77, R80 and the input impedance of Q16, the horizontal driver. Q16 is operated as a switch which supplies the proper driving current waveform to the base of Q17, the horizontal output transistor. The current driving pulse causes the output stage to alternately conduct or be cut off. When Q17 conducts, a constant potential is placed across the parallel combination of the deflection yoke and horizontal output transformer. This causes a linearly increasing current to flow through the horizontal deflection coils. As a result, the electron beam in the picture tube moves linearly from left to right across the face of the tube.

When Q17 is turned off, the magnetic field of the deflection coil collapses and the current flowing through the coils changes direction very rapidly. This charges the distributed and actual capacity of the circuit. When the electron beam in the picture tube changes direction, it returns quickly to the left side of the tube face. This is the flyback time. At the same time, the retrace pulse on the collector of Q17 is stepped up to a much larger value by transformer T3, and rectified by rectifier V2. This voltage is the accelerating potential for the picture tube.

The distributed capacity of the circuit now discharges through T3 and the voltage on the collector of Q17 decreases rapidly until the cathode of damper diode CR6 falls below the B+ line voltage. When this happens, CR6 conducts and maintains a constant voltage across the deflection coils. The electron beam is now being moved across the left portion of the picture tube face. By the time the charge from the distributed and actual capacity has been dissipated, Q17 will again conduct (due to a new signal) and maintain the voltage across the deflection coils. The current through the coils will again increase linearly to provide another sweep of the electron beam across the face of the picture tube. The entire process is repeated at a frequency of 15, 750 cps.

f. Picture Tube

As explained in the paragraph on the horizontal deflection system, the accelerating potential is obtained from the rectified output of tube V2. The brightness control R31, is a part of a voltage divider in the +100-volt supply line. The voltage divider is composed of R31 and R30. Varying the brightness control, R31 varies the bias voltage on the cathode of the picture tube. A vertical blanking signal derived from the vertical deflection coil is applied to grid G1 of the picture tube. A horizontal blanking signal derived from the horizontal output transformer is applied to grid G2.

g. Power Supply and Voltage Regulator

The power supply uses four silicon rectifiers to form a full-wave bridge rectifier.

The voltage regulator provides constant output voltage for input line variations from 98 to 135 v a-c. In operation, R98 (B+ ADJ) varies the divider network so that the output voltage is compared to reference diode CR15. Any difference detected is amplified by Q18 and Q19 and the correction signal is applied to Q20 which drives regulator Q21. R11 shunts regulator Q13 to reduce the transistor current as the voltage increases. This keeps the power dissipation rather low. Fuse F1 and resistor R110 protect Q21 against current surges which may occur if the B+ supply is shorted to ground.

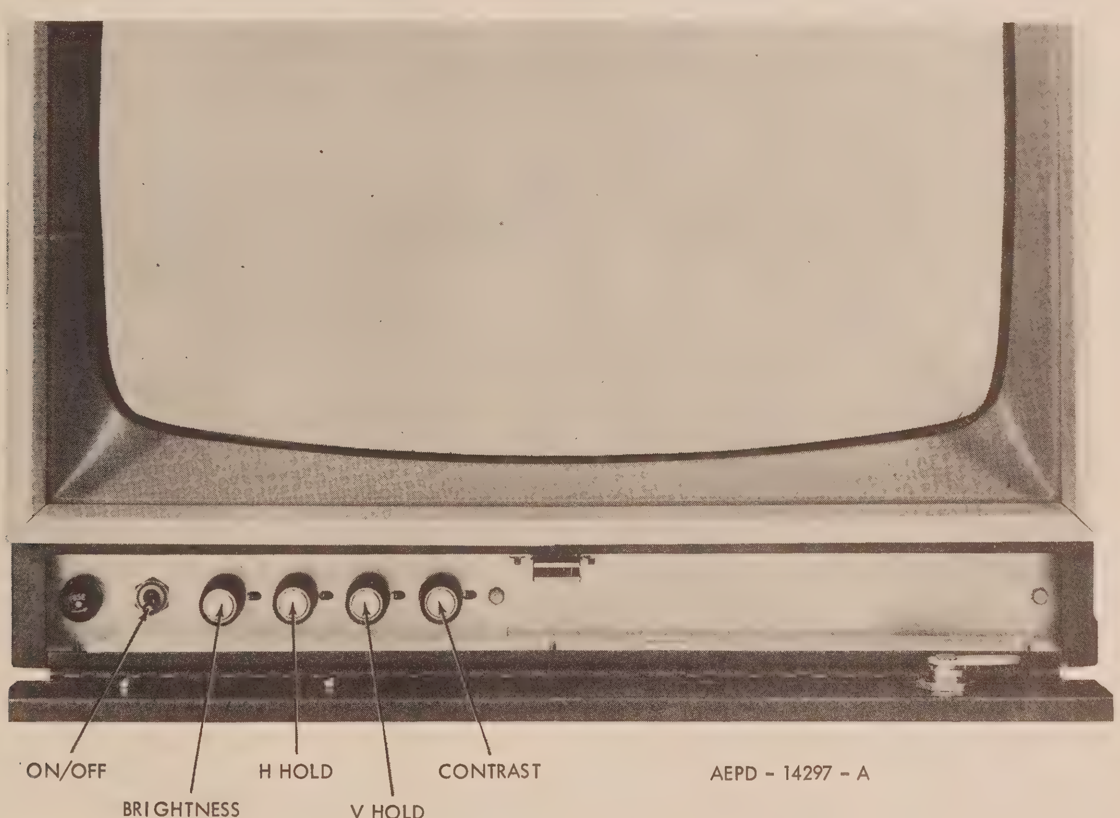


Figure 3.
Front Panel Controls

MAINTENANCE AND ADJUSTMENTS

1. SERVICING PROVISIONS

Access to all components is possible by removing the six screws holding the left rear cover (larger of the two) and swinging the cover out on its hinge.

2. GENERAL AND PREVENTIVE MAINTENANCE

Certain forms of maintenance should be performed at regular intervals to insure the best performance of the monitor. Of these, dust removal is probably one of the most important. The high voltage employed in the modern picture tube results in an accumulation of dust which is due to electrostatic attraction. The picture tube and the high voltage anode should be wiped occasionally with a soft dry cloth.

3. ADJUSTMENT AND ALIGNMENT

All controls, both primary and secondary, should be initially set to the mid-range positions.

a. B+ Adjustment

(1) Measure B+ from fuse F2 located on the printed circuit board to ground.

(2) Adjust R58 (B+ ADJ) to 75 volts.

b. Horizontal Hold Adjustment

(1) Set all controls for normal picture, as described in the OPERATING INSTRUCTIONS.

(2) Adjust horizontal hold (H HOLD) control fully clockwise.

(3) Adjust horizontal oscillator coil L6 until picture tears three to six bars from left side of the picture, then return control to midrange.

WARNING

Very high voltages are generated in the video monitor. Death on contact can result. Remove power cord and discharge high voltage before attempting any maintenance.

An occasional readjustment of the controls will compensate for picture tube and transistor aging thereby providing optimum performance.

CAUTION

Since this picture tube has integral implosion protection, replace only with the same type of tube.

To replace the high voltage rectifier tube V2, remove the screw holding the cover and swing the cover back to expose the tube.

c. Height and Vertical Linearity Adjustment

(1) Adjust HEIGHT control until lower portion of picture appears normal.

(2) Adjust vertical linearity (VERT LIN) until upper portion of picture appears normal.

(3) Readjust HEIGHT and vertical linearity (VERT LIN) controls as necessary to obtain best balance of control settings for minimum stretch or compression of picture.

NOTE

Resetting of the vertical hold control may be necessary during the above adjustments.

d. Picture Centering

Picture centering is accomplished by magnetic means using the centering device located on the picture tube neck.

(1) Start with megnetic centering device arms together (for minimum field strength) and in the horizontal plane.

(2) Separate arms of centering device to center picture vertically.

(3) Adjust horizontal centering by rotating magnetic centering device, as a unit, clockwise or counterclockwise as necessary. Readjust vertical centering as necessary by slightly repositioning the centering arms.

e. Deflection Yoke Adjustment

(1) Inspect location of yoke with respect to flare of picture tube. Yoke should be tight against tube flare for best focus, minimum distortion, and elimination of neck shadow.

(2) To adjust yoke, loosen retaining clamp and move yoke as far forward against tube flare

as possible. Rotate yoke until picture is horizontal without tilt, and retighten clamp.

4. PRINTED CIRCUIT BOARD REMOVAL

a. Remove six screws holding the left rear cover.

b. Swing out cover.

c. Disconnect cables and leads as follows:

(1) Remove picture tube socket.

(2) Disconnect high voltage connector.

NOTE

Discharge high voltage by shorting connector to ground.

(3) Disconnect only those leads that come from the board.

d. Remove the 13 screws holding board.

e. Remove the board.

f. To replace the board, reverse the procedure.

5. PICTURE TUBE REMOVAL AND REPLACEMENT

Before attempting to remove the picture tube there are certain precautions that should be exercised. A picture tube is very highly evacuated and breaking it will cause an implosion which may result in personal injury.

WARNING

Do not bump tube against hard objects.

Do not exert side pressure on neck of tube.

Wear safety goggles, shop coat, and gloves when handling tube.

Always place tube face down on a soft, flat surface.

Keep tube away from places where it may fall or otherwise be subjected to possible damage.

a. Picture Tube Removal

CAUTION

The picture tube acts as a capacitor and will have stored a considerable charge from the high voltage required to operate it. This must be discharged before the tube is handled. Discharge by grounding high voltage connector to chassis or shorting it to picture tube coating.

(1) Remove six screws holding left rear cover and swing it out.

(2) Unplug picture tube socket.

(3) Remove deflection yoke.

(4) Remove second anode connector.

(5) Remove three screws holding control panel to cabinet and lift out panel.

(6) Remove six screws holding right rear cover and place cover with printed circuit board up.

(7) Place cabinet face down.

(8) Remove four picture tube mounting bolts, one at each corner. Do not misplace grounding spring.

(9) Carefully remove tube from cabinet and place it face down on clean, soft cloth.

b. Picture Tube Replacement

(1) Insert picture tube in cabinet face down and center it.

(2) Replace the four picture tube mounting bolts and grounding spring.

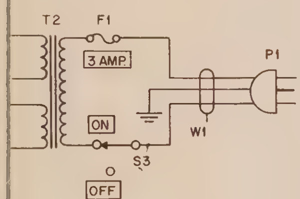
(3) Tighten four picture tube mounting bolts.

(4) Reverse steps (1) through (4) of removal procedure for rest of installation.

TROUBLESHOOTING

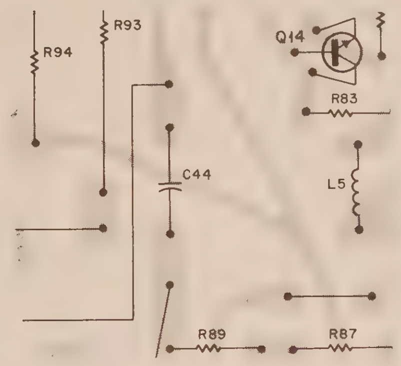
If any failures should occur in the video monitor, a qualified serviceman should perform the troubleshooting and repair. An understanding of the Theory of Operation and Maintenance and Adjustments will be most helpful for efficient trouble-shooting. Refer to the schematic diagram for detailed circuit information and voltage measurements.

Generally, the visual indication of the symptom can be used to localize the trouble to a specific circuit. Voltage measurements can then be used to help determine the malfunctioning component. Replace the component with the exact Motorola type shown in the Parts List on the back of the monitor schematic.



REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	SLN6148A	F3	ADDED	TOP LEFT OF BOARD
	SLN6163A	L7, R101	ADDED	LOWER LEFT OF BOARD
B	SLN6148A	CR2	REMOVED, WAS PARALLEL WITH R31	LOWER CENTER OF BOARD
C	SLN6148A-1	R103, CR18	ADDED	LOWER LEFT OF BOARD
		C44	RELOCATED; WAS AS SHOWN BELOW	LOWER LEFT OF BOARD



DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
D	SLN6148A-2	R92	WAS 15 OHMS	SCHEM. DIAG. & PARTS LIST
	SLN6148A-3		EXTENSIVE CIRCUIT AND COMPONENT CHANGES	
	SLN6148A-4 SLN6163A-1			REFER TO PEPD-18021

MODEL TABLE

MODEL	SUFFIX
SLN6146A	1
SLN6148A	3
SLN6163A	
SCN6125A	

FOR MODELS SUFFIXED LATER THAN INDICATED IN THE ABOVE TABLE, REFER TO CIRCUIT BOARD DETAIL PEPD-18021.

EPD-18024-O

CCTV Video Monitor
Printed Circuit Board Detail
Motorola No. EPD-14300-D
2/24/67-UP

TROUBLESHOOTING

If any failures should occur in the video monitor, a qualified serviceman should perform the troubleshooting and repair. An understanding of the Theory of Operation and Maintenance and Adjustments will be most helpful for efficient troubleshooting. Refer to the schematic diagram for detailed circuit information and voltage measurements.

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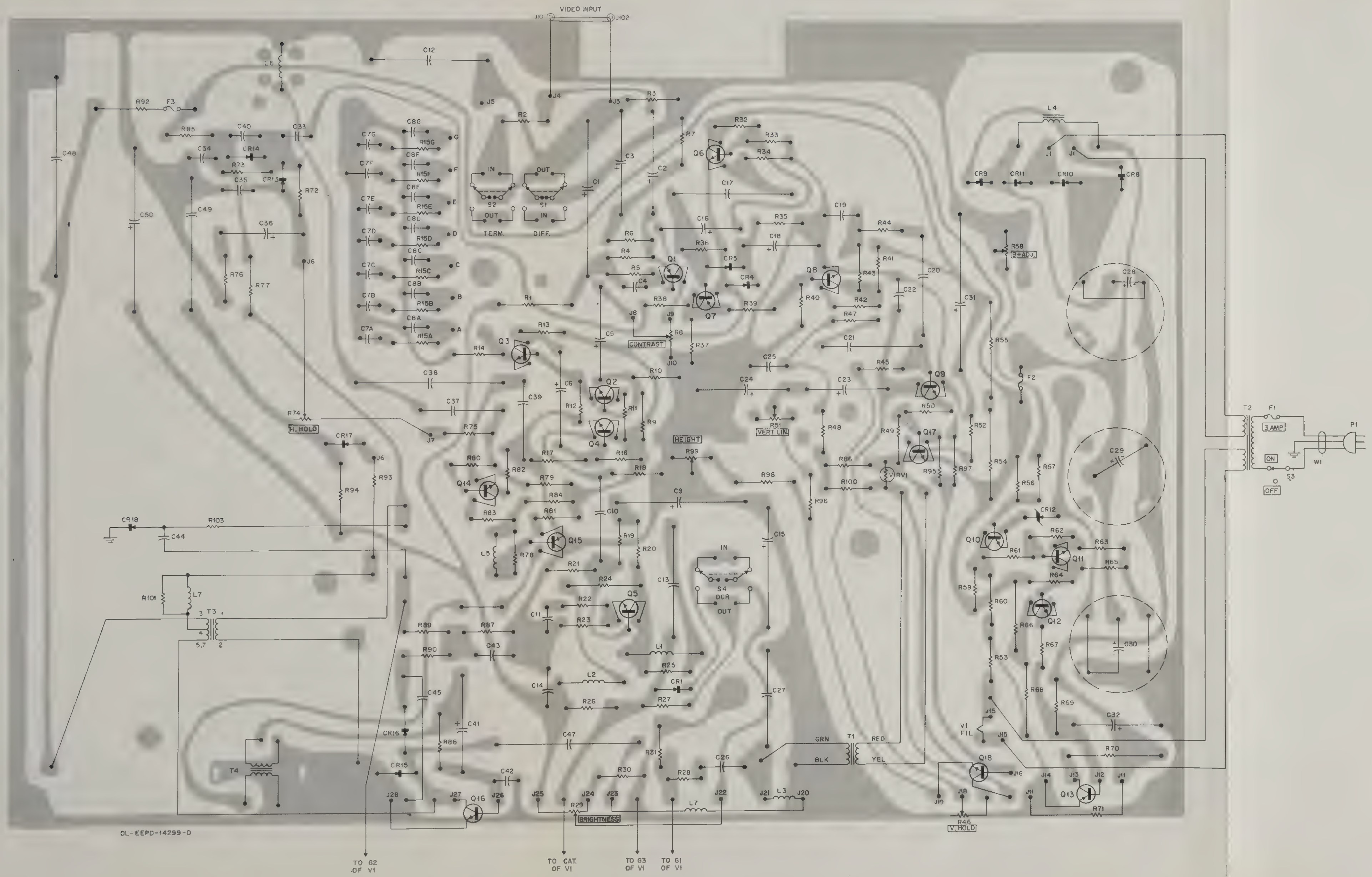
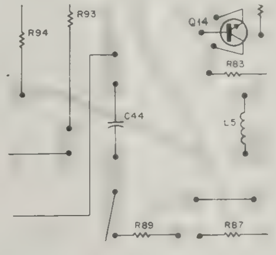


REVISIONS

DIAG ISSUE	CHASSIS AND SUFFIX NO.	REF SYMBOL	CHANGE	LOCATION
A	SLN6148A	F3	ADDED	[illegible]
	SLN6163A	L7, R101	ADDED	LOWER LEFT OF BOARD
B	SLN6148A	CR2	REMOVED; WAS PARALLEL WITH R31	[illegible] TER OF BOARD
C	SLN6148A-1	R103, CR18	ADDED	LOWER LEFT OF BOARD
		C44	RELOCATED; WAS AS SHOWN BELOW	LOWER LEFT OF BOARD
D	SLN6148A-2	R92	WAS 15 OHMS	SCHEM. DIAG. & PARTS LIST
	SLN6148A-3		EXTENSIVE CIRCUIT AND COMPONENT CHANGES	
	SLN6148A-4 SLN6163A-1			REFER TO PEPD-18021



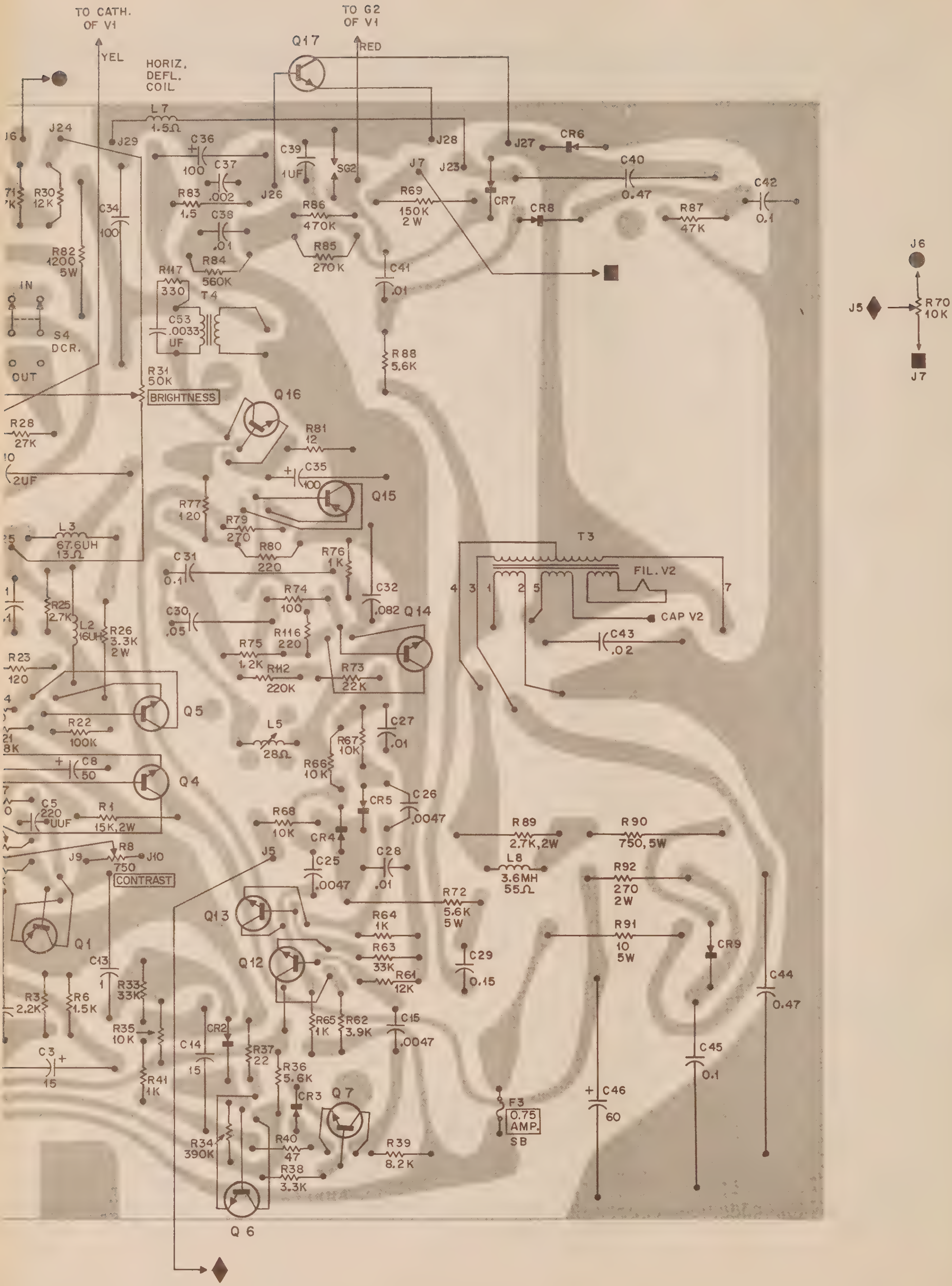
MODEL TABLE

MODEL	SUFFIX
SLN6146A	1
SLN6148A	3
SLN6163A	
SCN6125A	

FOR MODELS SUFFIXED LATER THAN INDICATED IN THE ABOVE TABLE, REFER TO CIRCUIT BOARD DETAIL PEPD-18021.

EPD-18024-O

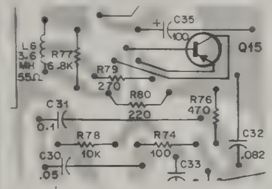
CCTV Video Monitor
Printed Circuit Board Detail
Motorola No. EPD-14300-D
2/24/67-UP



TO CATH. OF V1
YEL
TO G2 OF V1
RED
Q17
HORIZ. DEFL. COIL
L7 1.5Ω
J6
J24
J29
C36 100
C37 .002
J28
J27
CR6
J26
C39 1UF
SG2
J7
J23
C40 0.47
C42 0.1
R71
R30 12K
R83 1.5
C38 .01
R86 470K
R69 150K 2W
CR7
CR8
R87 47K
C34 100
R82 1200 5W
R84 560K
R85 270K
C41 .01
R117 330
T4
C53 .0033 UF
IN
S4 DCR.
OUT
R88 5.6K
R31 50K
BRIGHTNESS
Q16
R28 27K
R81 12
2UF
C35 100
Q15
R77 120
R79 270
L3 67.6UH 13Ω
R80 220
R76 1K
T3
C31 0.1
C32 .082
4 3 1 2 5
FIL. V2
7
R25 2.7K
R74 100
Q14
L2 16UH
R26 3.3K 2W
C30 .05
R116 220
CAP V2
C43 .02
R23 120
R75 1.2K
R112 220K
R73 22K
Q5
R22 100K
L5 28Ω
C27 .01
R67 10K
C8 50
Q4
R66 10K
CR5
C26 .0047
C5 220 UUF
R1 15K, 2W
R68 10K
CR4
R89 2.7K, 2W
R90 750, 5W
J9
R8 750
J10
CONTRAST
J5
C25 .0047
C28 .01
L8 3.6MH 55Ω
R92 270 2W
Q1
Q13
R72 5.6K 5W
R64 1K
R91 10 5W
C13 1
Q12
R63 33K
C29 0.15
CR9
R3 2.2K
R6 1.5K
R33 33K
R61 12K
C44 0.47
R35 10K
CR2
R65 1K
R62 3.9K
C15 .0047
C14 15
R37 22
C45 0.1
C3 15
R41 1K
R36 5.6K
CR3
Q7
F3 0.75 AMP. SB
C46 60
R34 390K
R40 47
R39 8.2K
R38 3.3K
Q6
R70 10K

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
[illegible]	[illegible]	R29	WAS 6S6074, 68K	TOP OF CKT BD
		R60	WAS 6S6320, 10K	
		[illegible]	[illegible]	[illegible] LECTOR
		Q14	48R869338, TYPE M9338	HORIZ. OSC.
		[illegible]	[illegible]	V1-G3
		[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]
[illegible]	SLN6148A-6	C33	WAS 8D82905G23, .02 uf REPLACES WITH R116	Q14 COL-LECTOR
		[illegible]	[illegible], 470	Q14 EMITTER
		[illegible]	[illegible]	[illegible] LECTOR
		[illegible]	[illegible]	T4 PRIMARY
		C53	ADDED .0033 uf	
		L6	REMOVED 24D67324A30, 3.6 MH CIRCUIT WAS AS SHOWN BELOW	RIGHT SIDE OF CKT. BD.
		R78	REMOVED 6S6320, 10K, CIRCUIT WAS AS SHOWN BELOW	
C	SLN6148A-7	R68	WAS 6S5659, 3.9K	LOWER RT. OF CKT BD
		[illegible]	WAS 6S6079, 6.8K	TOP RT. OF CKT BD
		R71	WAS 6S6393, 1.2K	
	[illegible] N6125A-2	R70	WAS 18K82515B37, [illegible]	

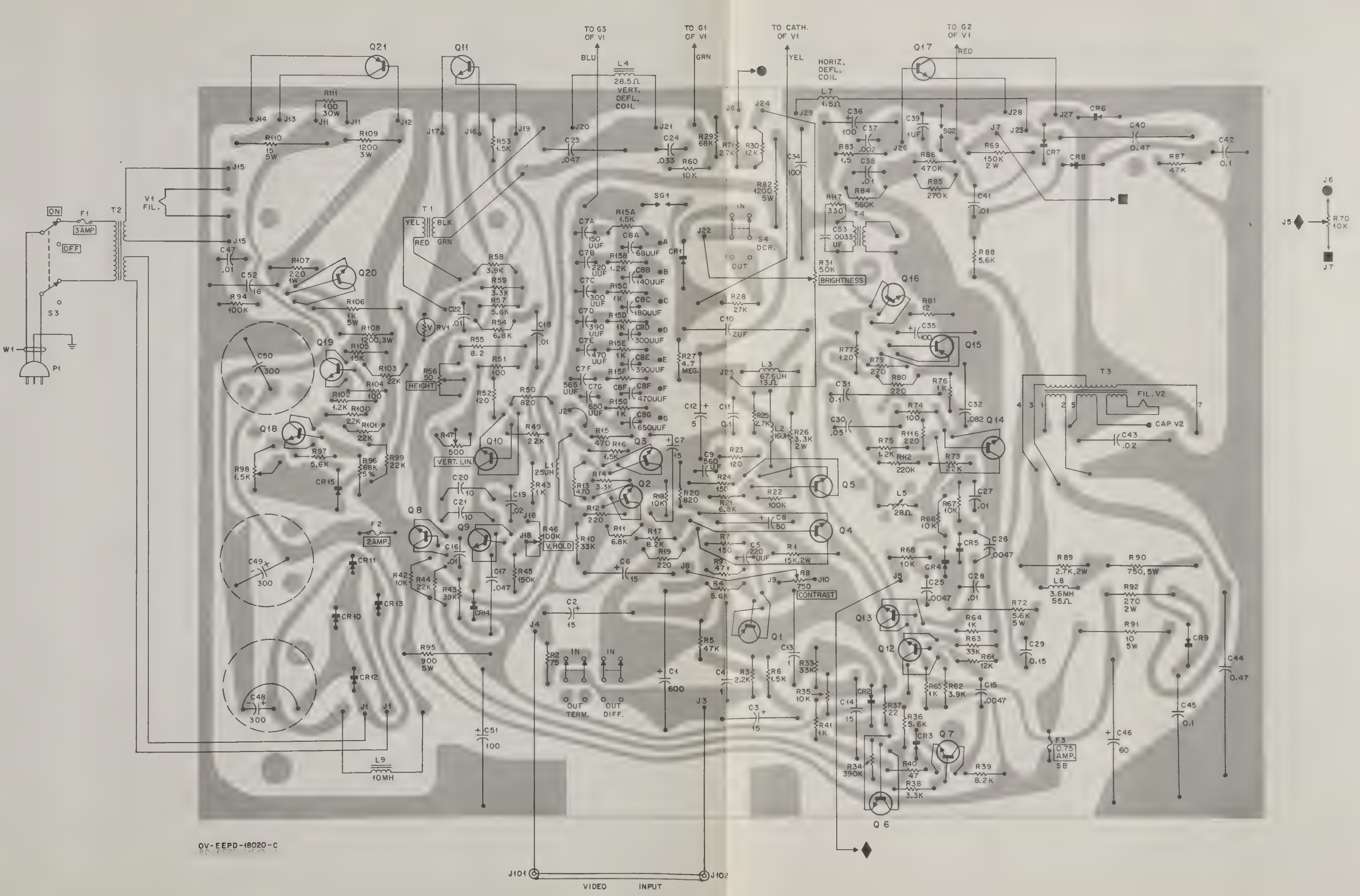


MODEL TABLE

MODEL	SUFFIX
SLN6146A	2
SLN6148A	4
SLN6163A	1
SCN6125A	1

FOR MODELS SUFFIXED EARLIER THAN INDICATED IN THE ABOVE TABLE, REFER TO CIRCUIT BOARD DETAIL EPD-14300.

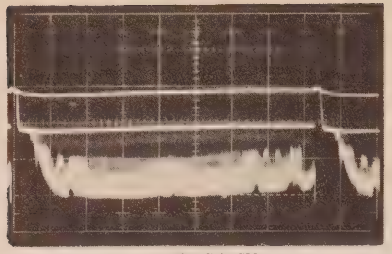
EPD-18025-O



Video Monitor
Printed Circuit Board Detail
Motorola No. PEPD-18021-C
5/7/68-UP

WF1

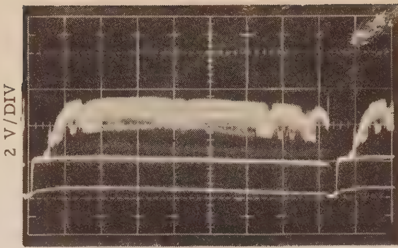
2 V/DIV



2 MSEC/DIV

WF2

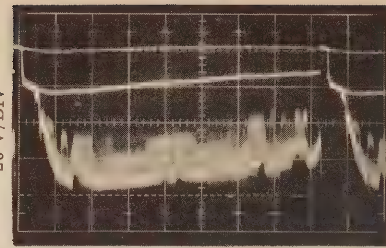
2 V/DIV



2 MSEC/DIV

WF3

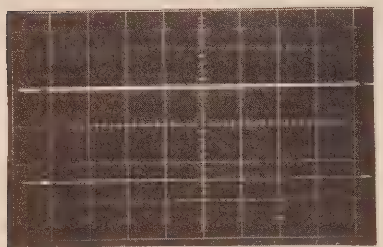
20 V/DIV



2 MSEC/DIV

WF4

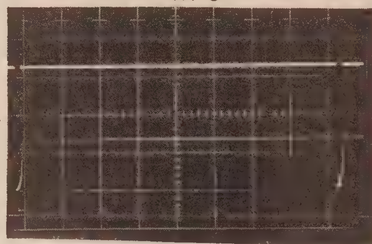
0.5 V/DIV



2 MSEC/DIV

WF5

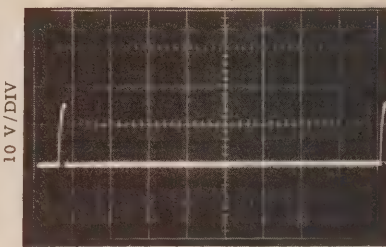
10 V/DIV



2 MSEC/DIV

WF6

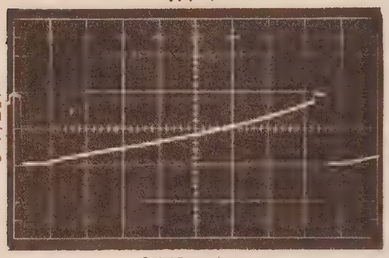
10 V/DIV



2 MSEC/DIV

WF7

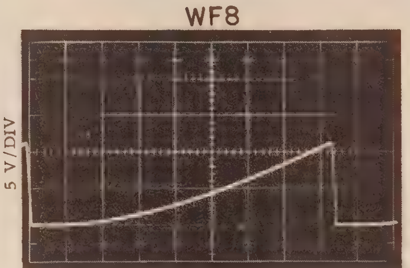
5 V/DIV



2 MSEC/DIV

WF8

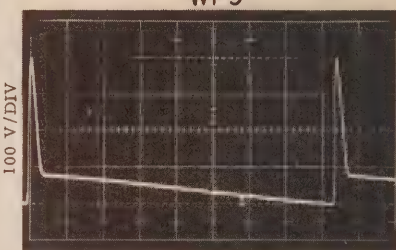
5 V/DIV



2 MSEC/DIV

WF9

100 V/DIV



2 MSEC/DIV

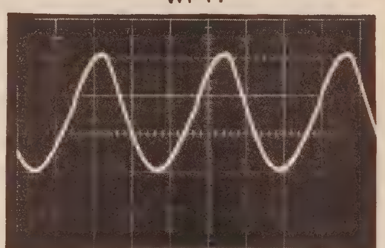
WF10

5 V/DIV

20 USEC/DIV

WF11

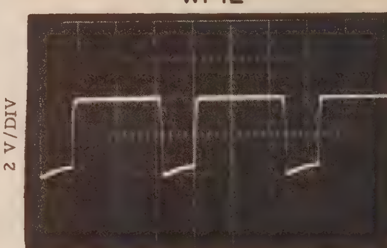
0.5 V/DIV



20 USEC/DIV

WF12

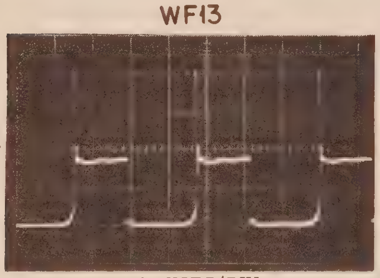
2 V/DIV



20 USEC/DIV

WF13

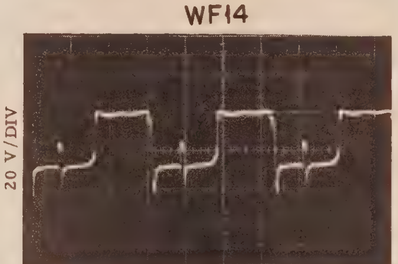
10 V/DIV



20 USEC/DIV

WF14

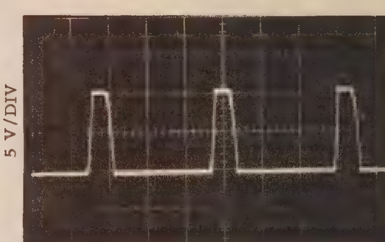
20 V/DIV



20 USEC/DIV

WF15

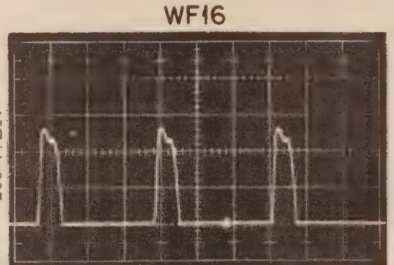
5 V/DIV



20 USEC/DIV

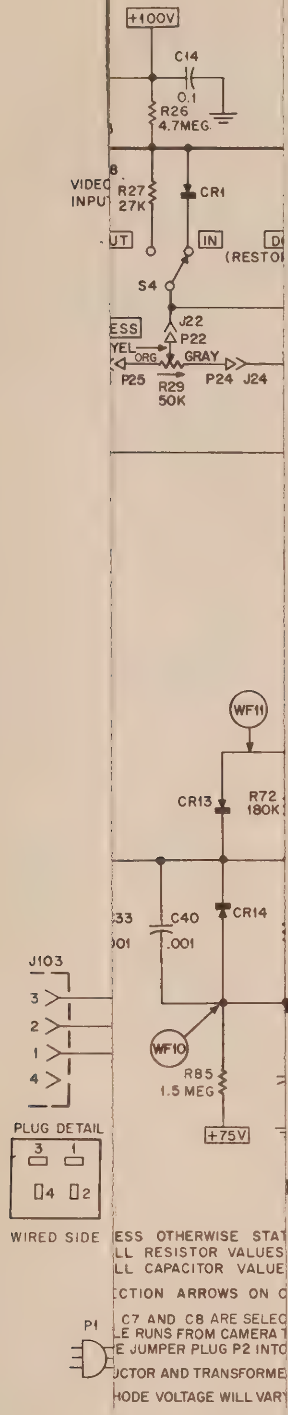
WF16

200 V/DIV



20 USEC/DIV

Monitor Waveform Detail
For Models SLN6146A-2, SLN6148A-4,
SLN6163A-1 and SCN6125A-1
Motorola No. EPD-18045-O
2/24/67-UP



MODEL TABLE

MODEL	SUFFIX
SLN6146A	1
SLN6148A	3
SLN6163A	
SCN6125A	

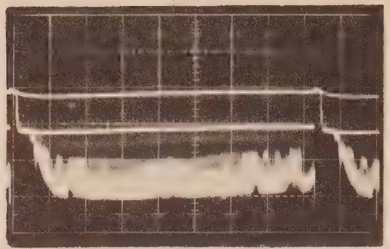
FOR MODELS SUFFIXED LATER THAN INDICATED IN THE ABOVE TABLE, REFER TO SCHEMATIC DIAGRAM 63E81051A99.

EPD-18022-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

CCTV Video Monitor
Schematic Diagram
Motorola No. 63E81039A26-D
2/24/67-UP

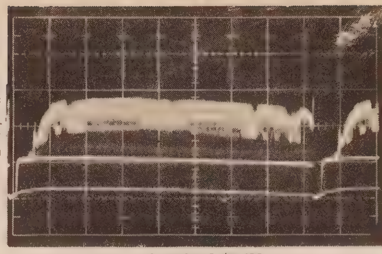
WF1



2 V/DIV

2 MSEC/DIV

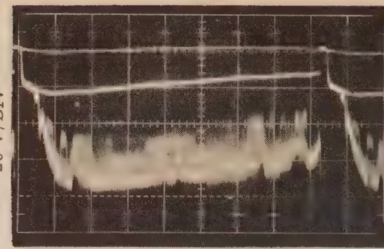
WF2



2 V/DIV

2 MSEC/DIV

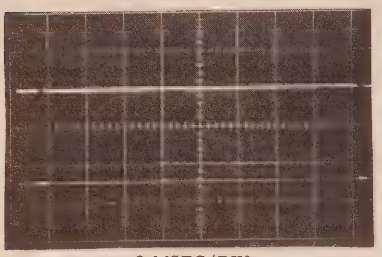
WF3



20 V/DIV

2 MSEC/DIV

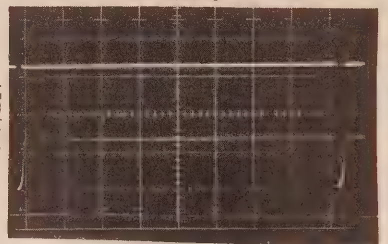
WF4



0.5 V/DIV

2 MSEC/DIV

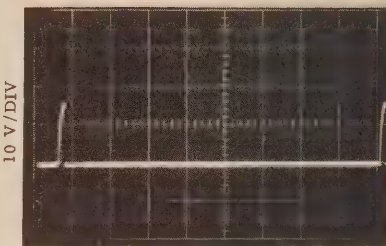
WF5



10 V/DIV

2 MSEC/DIV

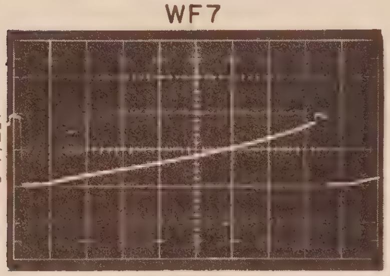
WF6



10 V/DIV

2 MSEC/DIV

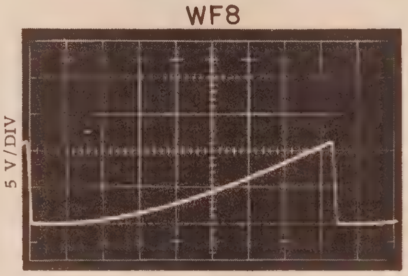
WF7



5 V/DIV

2 MSEC/DIV

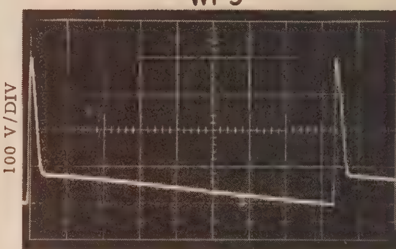
WF8



5 V/DIV

2 MSEC/DIV

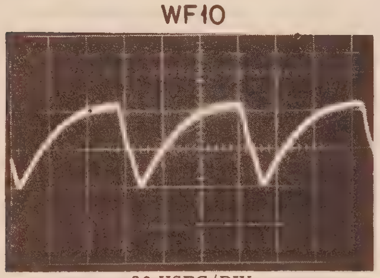
WF9



100 V/DIV

2 MSEC/DIV

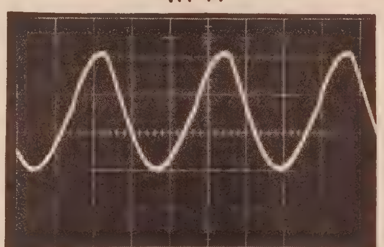
WF10



5 V/DIV

20 USEC/DIV

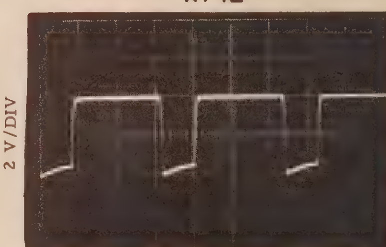
WF11



0.5 V/DIV

20 USEC/DIV

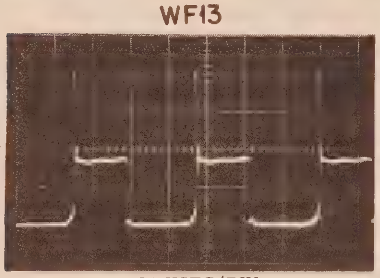
WF12



2 V/DIV

20 USEC/DIV

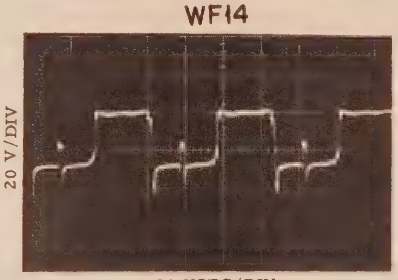
WF13



10 V/DIV

20 USEC/DIV

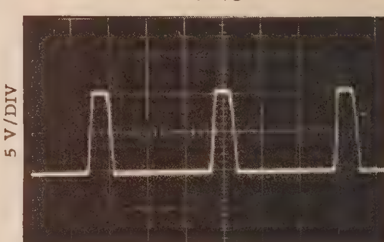
WF14



20 V/DIV

20 USEC/DIV

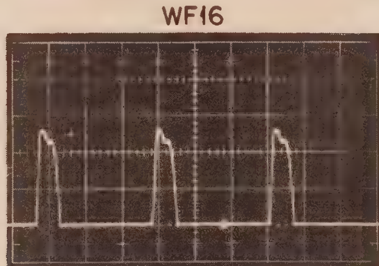
WF15



5 V/DIV

20 USEC/DIV

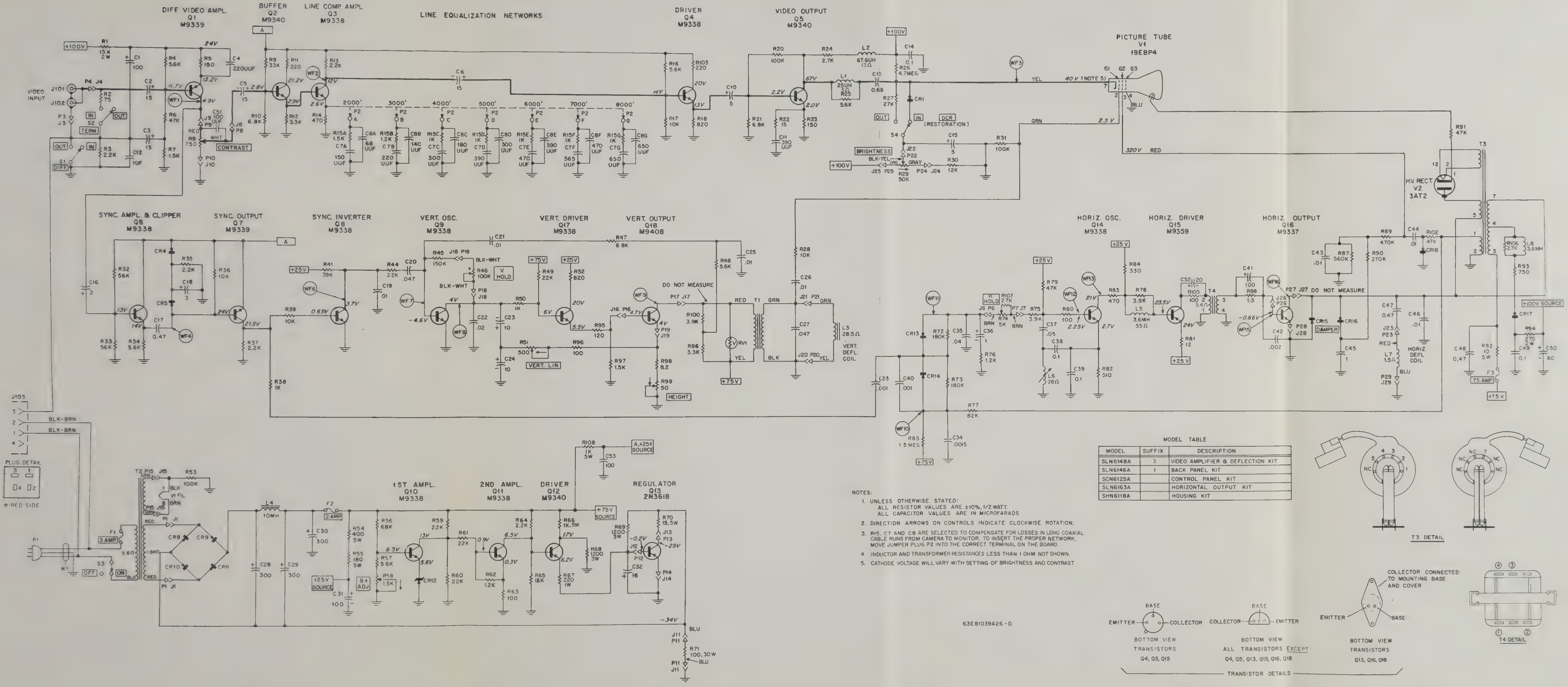
WF16



200 V/DIV

20 USEC/DIV

Monitor Waveform Detail
For Models SLN6146A-2, SLN6148A-4,
SLN6163A-1 and SCN6125A-1
Motorola No. EPD-18045-O
2/24/67-UP



MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
SLN6148A	3	VIDEO AMPLIFIER & DEFLECTION KIT
SLN6146A	1	BACK PANEL KIT
SCN6125A		CONTROL PANEL KIT
SLN6163A		HORIZONTAL OUTPUT KIT
SHN6118A		HOUSING KIT

NOTES:

1. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES ARE ±10%, 1/2 WATT.
   ALL CAPACITOR VALUES ARE IN MICROFARADS
2. DIRECTION ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION.
3. R15, C7 AND C8 ARE SELECTED TO COMPENSATE FOR LOSSES IN LONG COAXIAL CABLE RUNS FROM CAMERA TO MONITOR. TO INSERT THE PROPER NETWORK, MOVE JUMPER PLUG P2 INTO THE CORRECT TERMINAL ON THE BOARD.
4. INDUCTOR AND TRANSFORMER RESISTANCES LESS THAN 1 OHM NOT SHOWN.
5. CATHODE VOLTAGE WILL VARY WITH SETTING OF BRIGHTNESS AND CONTRAST

MODEL TABLE

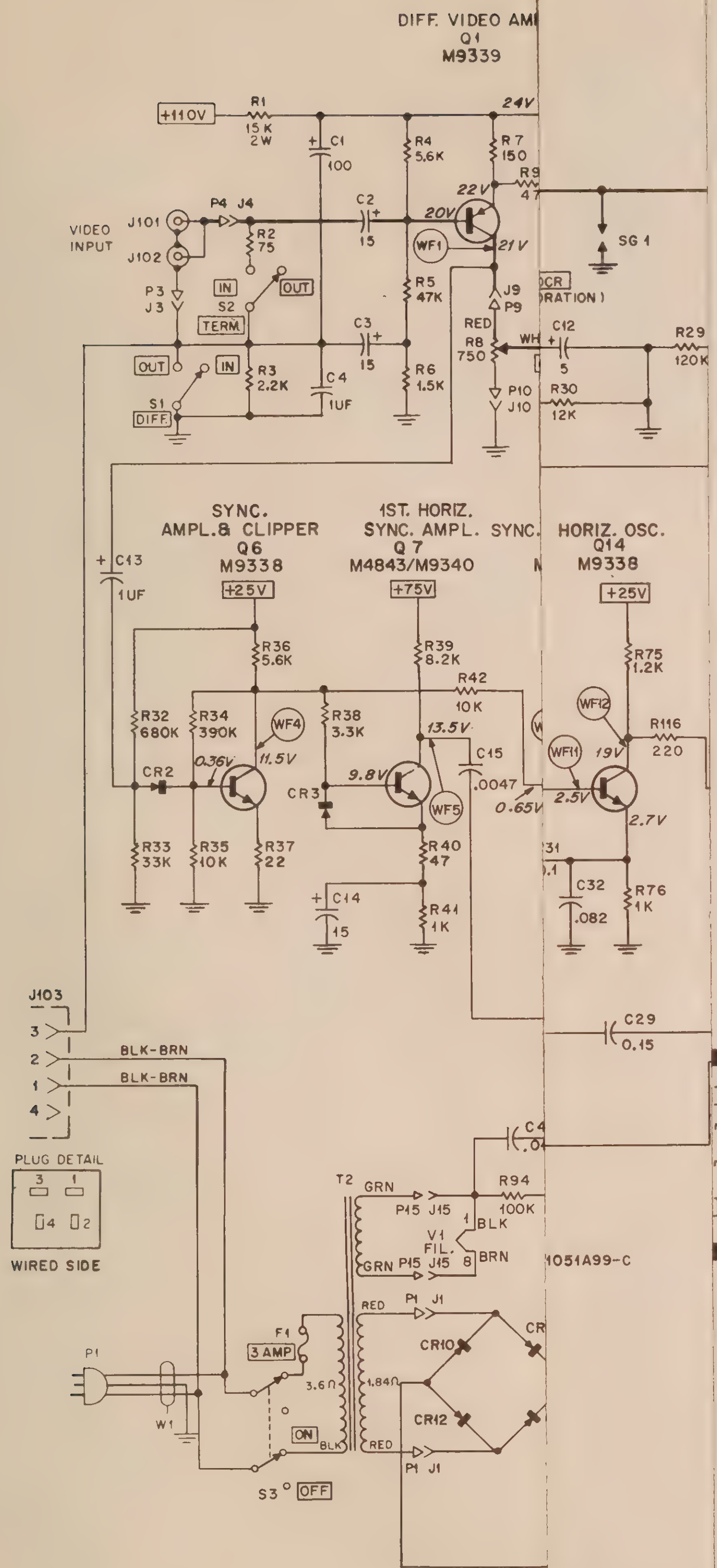
MODEL	SUFFIX
SLN6146A	1
SLN6148A	3
SLN6163A	
SCN6125A	

FOR MODELS SUFFIXED LATER THAN INDICATED IN THE ABOVE TABLE, REFER TO SCHEMATIC DIAGRAM 63E81051A99.

EPD-18022-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

CCTV Video Monitor
Schematic Diagram
Motorola No. 63E81039A26-D
2/24/67-UP



RE ±10%, 1/2 WATT.
ARE IN MICROFARADS
TROLS INDICATE CL
TO COMPENSATE FOR
MONITOR. TO INSERT TH
E CORRECT TERMINAL
ESISTANCES LESS THAN
ITH SETTING OF BRIGHT

MODEL TABLE

MODEL	SUFFIX
SLN6146A	2
SLN6148A	4
SLN6163A	1
SCN6125A	1

FOR MODELS SUFFIXED EARLIER THAN INDICATED IN THE ABOVE TABLE, REFER TO SCHEMATIC DIAGRAM 63E81039A26.

EPD-18023-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

CCTV Video Monitor
Schematic Diagram
Motorola No. 63E81051A99-C
5/7/68-UP

REVISIONS

DIAG ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
[illegible]	SLN6148A	C11	WAS 21K848236, 650 uuf ±5%; 300 V	PARTS LIST
		C14	WAS 21D82428B22, .01 ±20%; 1000 V	
		C18	WAS 23D82601A04, 2 +250-10%; 25 V	
		R75	WAS 6S6117, 5.6K	
		R50	WAS 6S6040, 680	
		R92	WAS 17K868696, 10; 5 W	
		R82	WAS 6S6022, 330	
		R87	WAS 6S2096, 330K	
		R45	WAS 6S6398, 150K	
		CR2	REMOVED WAS CONNECTED IN PARALLEL WITH R31	V1-G1
	SCN6125A	C51	ADDED	COLLECTOR Q1
		R102	ADDED	Q14 BASE CIRCUIT
A	SLN6148A-1	R103	ADDED	TB3-1
		CR18	ADDED	TB3-1
B	SLN6148A-2	R92	WAS 17C82291B06, 15	T3-3
C	SLN6146A-1	Q13	WAS 48R869359, M9359	REGULATOR
	SLN6148A-3	C4	WAS 21D82537B06, 470 uuf	Q1 EMITTER
		C9	REMOVED 23D82601A14, 5 uf WAS CONNECTED BETWEEN GROUND AND JUNCTION OF R19, R20	Q4 EMITTER CIRCUIT
		C11	WAS 21K848236, 650 uuf	Q5 EMITTER CIRCUIT
		C19	WAS 21K859471, .02 uf	Q8 COLLECTOR CIRCUIT
		C52	ADDED 20 uf	Q15 COL.
		C53	ADDED 100 uf	Q12 DRIVER
		R[illegible]	WAS 6S6397, 22K	Q2 BASE
		R13	WAS 6S6040, 680	Q3 COL.
		R19	REMOVED 6S6048, 47K. WAS CONNECTED BETWEEN Q5 BASE AND JUNC. OF C9, R20	Q5 BASE
		R20	WAS 6S6048, 47K	Q5 COL.
		R22	WAS 6S2036, 33	Q5 EMITTER
		R41	WAS 6S6090, 470	Q8 COL. CIR.
		R42	REMOVED 6S6069, 2.2K. WAS CONNECTED BETWEEN Q8 COL. AND JUNC. OF R41, R43	
		R43	REMOVED 6S6487, 39K. WAS CONNECTED BETWEEN JUNC. R41, R42, AND C19, R44	
		R40	REMOVED 6S6229, 1K WAS CONNECTED BETWEEN GND. AND Q8 BASE.	Q8 BASE
		R44	WAS 6S5581, 3.3K	Q9 BASE CIR.
		R50	WAS 6S6038, 1.5K	Q17 BASE
		R64	WAS 6S6048, 47K	Q11 COL.
		R65	WAS 6S6397, 22K	Q12 BASE
		R66	WAS 6S5764, 2.7K	Q12 COL.
		R67	WAS 6S[illegible], 560	Q12 EMITTER
		R68	WAS 6S2[illegible], 1.5K	Q12 COL.
		R69	WAS 6S5[illegible], 3.3K	Q13 BASE
		R78	WAS 6S6320, 10K	Q15 BASE
		R103	REM. 6S6048, 4.7K	T3-1
		R54	WAS 17C82291B05, 180; 5 W	1ST. AMPL. Q10 BASE CIR.
		R102	WAS REF. R103	T3-1
		R105	ADDED 100	Q15 COL.
		R106	ADDED 2.7K	T3-4
		R107	WAS REF. R102	Q14 BASE CIR.
		R108	ADDED 1K	DRIVER Q12
		Q2	WAS 48R869338, M9338	BUFFER
		Q4	WAS 48R869209, M9209	DRIVER
		Q12	WAS 48R869338, M9338	
		Q15	WAS 48R869145, M9145	HORIZ. DRIVER
		L8	WAS REF. L7	T3-7
D	SCN6125A-1 SLN6146A-2 SLN6148A-4 SLN6163A-1		EXTENSIVE CIRCUIT AND COMPONENT CHANGES	SCHEM. DIAG. & PARTS LIST

PARTS LIST

SLN6148A Video Amplifier & Deflection Kit EPD-13628-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf; ±10%; unl stated
C1, 31	23C82077C01	100 +150-10%; 35 v
C2, 5	23C82013C01	15 +100-10%; 25 v
C3, [illegible]	23D82601A31	15 +150-10%; 25 v
C7A	21K840047	150 uuf ±5%; 500 v
C4, 7B	21K859942	220 uuf ±5%; 300 v
C7C, 8D	21K859944	300 uuf ±5%; 300 v
C7D, 8E, 11	21K859945	390 uuf ±5%; 300 v
C7E, 8F	21D82537B06	470 uuf ±5%; 300 v
C7F	21K863948	565 uuf ±5%; 500 v
C7G, 8G	21K848236	650 uuf ±5%; 300 v
C8A	21K873266	68 uuf ±2%; 500 v
C8B	21K865443	140 uuf ±3%; 500 v
C8C	21K865440	180 uuf ±3%; 500 v
C10	23K867671	5 +100-10%; 50 v
C12	8K859592	1 ±20%; 100 v
C13	8K863433	0.68; 150 v
C14	8C82095G08	.1; 400 v
C15	23D82601A14	5 +100-10%; 250 v
C16	23D82601A04	2 +250-10%; 25 v
C17	8K861614	0.47; 100 v
C18	23C82601A15	3 uf; 100 v
C19, 25, 26	21D82428B22	.01 ±20%; 1000 v
C20	8C82284C12	.047; 50 v
C21	8K847105	.01; 400 v
C22	21K859471	.02 ±20%; 50 v
C23, 24	23D82783B27	10; 25 v
C27	8K868503	.047; 400 v
C28, 29, 30	23D82394A09	300 +100-10%; 150 v
C32	23C82601A10	16 +33-10%; 10 v
C33, 40	21C82187B14	.001; 100 v
C34	21D82428B38	.0015 +100-0%; 500 v
C35	8S127404	.04 +30-20%; 50 v
C36	23D82601A16	1 +150-10%; 250 v
C37	8C82396B02	.05; 200 v
C38	8K864428	0.1; 100 v
C39	8S10072A03	0.1; 200 v
C41	23D82601A12	100 +150-10%; 6 v
C42	21D82428B28	.002; 200 v
C43, 44	21C82164B01	.01; 1000 v
C45	8B83300D01	1; 600 v
C47	8D82665G02	0.47; 200 v
C48	8C82927C04	0.47; 200 v
C49	8K865917	0.1; 400 v
C50	23C82341B01	60 +100-10%; 150 v
C52	23D82601A03	20 +100-0%; 25 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR1, 4, 5, 13, 14	48C82420C01	silicon
CR8, 9, 10, 11	48C82525G06	silicon
CR12	48D82256C12	silicon; zener type
CR15, 16	48C82466H25	silicon
CR17	48C82466H17	silicon
CR18	48C82420C10	silicon
		FUSE, cartridge: 1-1/4" x 1/4":
F2	65S42092	2 a; 250 v
F3	65K892099	3/4 a; 125 v; slow blow type
		COIL, RF:
L1	24D82480B04	choke; 25 uh
L2	24D82480B01	choke; 67.6 uh
L4	25C83605C01	choke; 10 mh
L5	24D67324A30	choke; 3.6 mh
L6	24V80905A05	tuning; res 40 ohms; incl. 1A82354B05 CORE, tuning
		TRANSISTOR: (NOTE)
Q1, 7	48R869339	P-N-P; type M9339
Q2, 12	48R869340	N-P-N; type M9340
Q3, 4, 6, 8, 9, 10, 11, 14, 17	48R869338	N-P-N; type M9338
Q5	48R869340	N-P-N; type M9340
Q1[illegible]	48R869359	P-N-P; type M9359
		RESISTOR, fixed: ±10%; 1/2 w; unl stated
R1	6S5732	15K; 2 w
R2	6S410020	75 ±5%
R3, 35, 37,	6S60[illegible]	2.2K
R4, 16, 25, 34, [illegible]	6S6117	5.6K
R[illegible], 23	6S6373	150

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R6, 79, 102	6S6048	47K
R7, 15A, 97	6S6038	1.5K
R9	6S6410	33K
R10, 21, 47	6S6428	6.8K
R11	6S2002	220 ±5%
R12, 86	6S5581	3.3K
R13	6S6069	2.2K
R14, 83	6S6090	470
R15B, 62, 76	6S6393	1.2K
R15C, 15D, 15E, 15F, 15G 38, 50	6S6229	1K
R17, 28, 36, 39	6S6320	10K
R18, 52	6S6269	820
R20, 31, 53	6R6031	100K
R22	6S2034	15
R24, 106	6S5764	2.7K; 2 w
R26	6S6446	4.7 meg
R27	6S6434	27K
R30	6S6394	12K
R32, 33	6S6378	56K
R41	6S6487	39K
R45	6S6398	150K
R44, 49, 59, 60, 61, 64	6S6397	22K
R51	18C82943G02	variable: 500 ±20%; 2 w
R54	17C82291B18	400; 5 w
R55	17C82291B05	180; 5 w
R56	6S6001	68K
R58	18C82943G06	variable: 1.5K ±20%; 2 w
R63, 80, 96, 105	6S6326	100
R65	6S6477	15K
R66	17C82291B17	1K; 5 w
R67	6S6389	220
R68, 69	17C82291B31	1.2K; 3 w
R70	17C82291B06	15; 5 w
R72, 73	6S6444	180K
R75, 78, 100	6S5659	3.9K
R77	6S5575	82K; 1 w
R81	6S2030	12
R82	6S5799	510 ±5%
R84	6S6022	330
R85	6R6460	1.5 meg
R87	6S5697	560K
R88	17A890466	1.5
R89	6S6377	470K
R90	6S129296	270K
R92	17K868696	10; 5 w
R93	17C82291B26	750; 5 w
R94	6S476116	270; 2 w
R95	6S5551	120
R98	17K892227	8.2 ±5%
R99	18C82943G05	variable: 50 ±20%; 2 w
R102	6S6048	47K
R108	17C82291B17	1K; 5 w
		VARISTOR:
RV1	6C66263A08	1 ma @ 120 v dc
		SWITCH, slide:
S1, 2, 4	40C83608C01	dpdt
		TRANSFORMER,
T1	25C83606C01	vertical blocking oscillator: c/o: pri: BLK, YEL; res 0.615 ohms sec: BLU, GRN; res 10.8 ohms
T4	25C83607C01	horizontal driver: c/o: pri: 3.8 ohms ±20% sec: .072 ohms ±20%

SLN6146A Back Panel Kit EPD-13629-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle: female:
J101, 102	9K867432	single cont.
J103	9A801241	4 cont.
		CONNECTOR, plug:
P101		male; 2 cont. (p/o W1)
		TRANSISTOR: (NOTE)
Q13	48R869336	P-N-P; type M9336
Q16	48R869337	N-P-N; type M9337
Q18	48R869408	N-P-N; type M9408
		RESISTOR, fixed:
R71	17C83620C01	100 ±10%; 30 w
		TRANSFORMER, power:
T2	25D83619C01	pri: BLK, BLK; res 3.5 ohms sec. No. 1; RED, RED; res 1.9 ohms sec. No. 2; GRN, GRN; res 0.25 ohm
		CABLE ASSEMBLY, power:
W1	30C865903	3 conductor: each conductor No. 18 ga; str; 8 ft. long overall; incl. "molded-on" 3-cont. male plug (P1)
		SOCKET, transistor:
XQ9, 13, 16	9D82673A01	female: 2 cont.
	NON-REFERENCED ITEM	
	14K865875	INSULATOR, transistor mounting (used with Q13, 16, 18)

SCN6125A Control Panel Kit EPD-13630-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: ±10%
C51	21K840046	100 uuf; 500 v
		FUSE, cartridge: 1-1/4" x 1/4"
F1	65K817955	slow blow type; 3 a; 125 v
		RESISTOR, variable: ±30% unl. stated
R8	18D82515B40	750; ±10%; 1/2 w
R29	18D82515B21	50K; 0.33 w
R46	18D82515B39	100K; 0.33 w
R74	18D82515B37	5K; 1/2 w
		RESISTOR, fixed: ±10%; 1/2 w
R107	6S5577	2.7K
		SWITCH, toggle:
S3	40A482097	spst
		FUSEHOLDER:
XF1	9B82080G01	extractor post type
	NON-REFERENCED ITEMS	
	15B83583C01	COVER, panel
	36B82629H01	KNOB, control; 4 req'd

SLN6163A Horizontal Output Kit EPD-14384-B

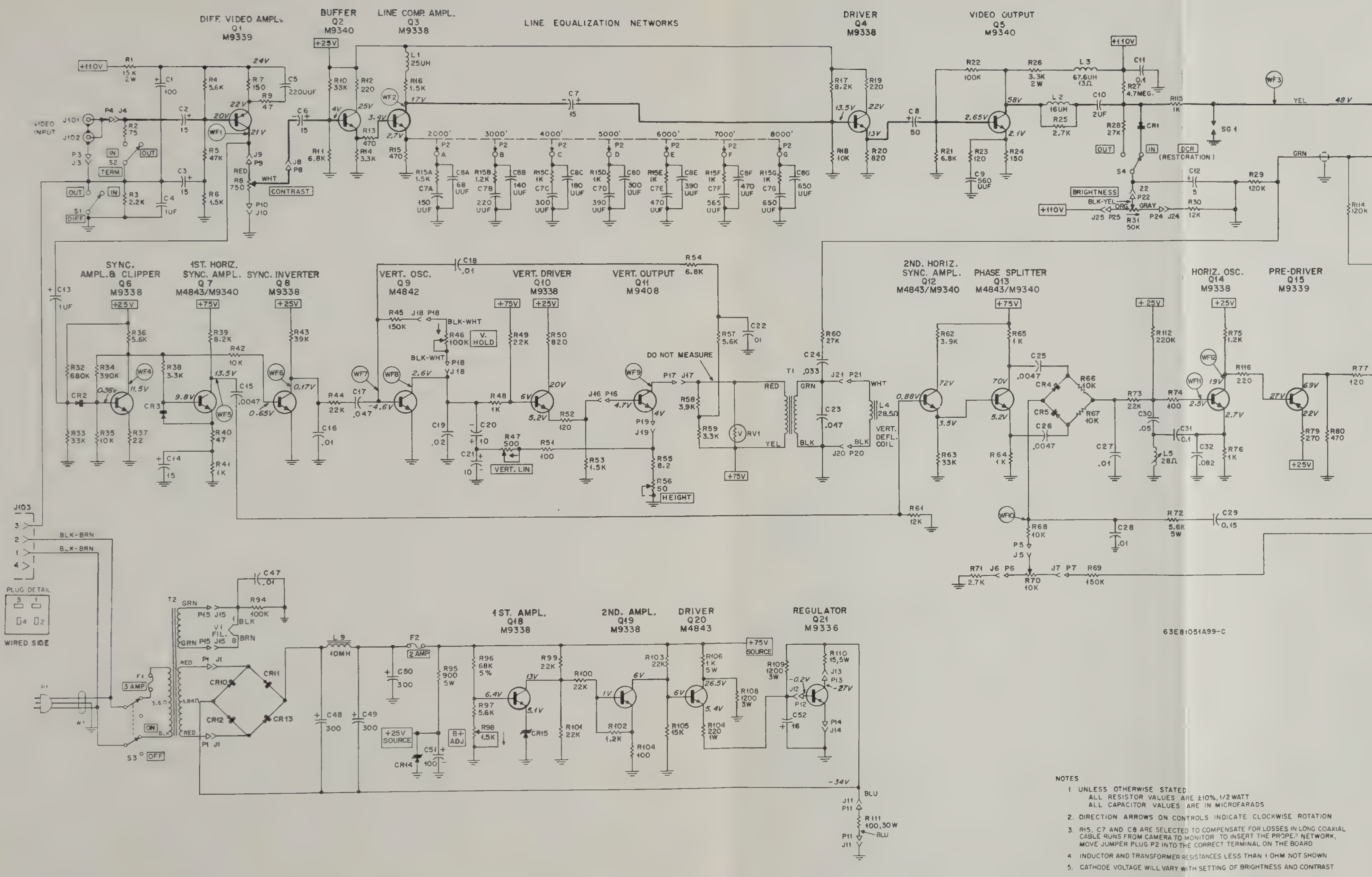
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L8	24D67324A30	COIL, r-f 3.6 mh; choke
C46	8K83894	CAPACITOR, fixed: .01 uf ±10%; 600 v
		RESISTOR, fixed:
R91	6S6462	47K ±10%; 1 w
R101	6S5764	2.7K; 2 w
T3	24D83600C01	TRANSFORMER, horizontal output
V2	95R354A01	ELECTRON TUBE: type 3AT2
XV2	9B83601C01	SOCKET, tube: duo decar; does not incl. 14C83945B01 INSULATOR
	NON-REFERENCED ITEMS	
	42K754321	CONNECTOR, picture tube anode
	1V80757A61	HIGH VOLTAGE SHIELD ASSEMBLY

SHN6118A Housing Kit EPD-13631-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L3, 7		COIL, picture tube deflection: (p/o 1V80757A59; see non-referenced items)
V1	96R138A01	ELECTRON TUBE: cathode ray; type 19EBP4
	NON-REFERENCED ITEMS	
	1V80757A59	DEFLECTION YOKE ASSEMBLY: incl. windings L3, L7
	30B82953E01	CABLE ASSEMBLY: incl. picture tube socket
	15D83594C01	CABINET
	42A83882C01	GROUNDING STRAP (for picture tube)
	75A82394C01	FOOT, cabinet: 4 req'd
	15C83597C01	COVER (for controls)
	13C83171C01	BEZEL (19")
	13D83130C01	MASK (for picture tube)
	55B83598C01	LOCK: incl. 2 keys and mounting hardware
	2C82360B11	SPEED NUT: 12 req'd

NOTE:

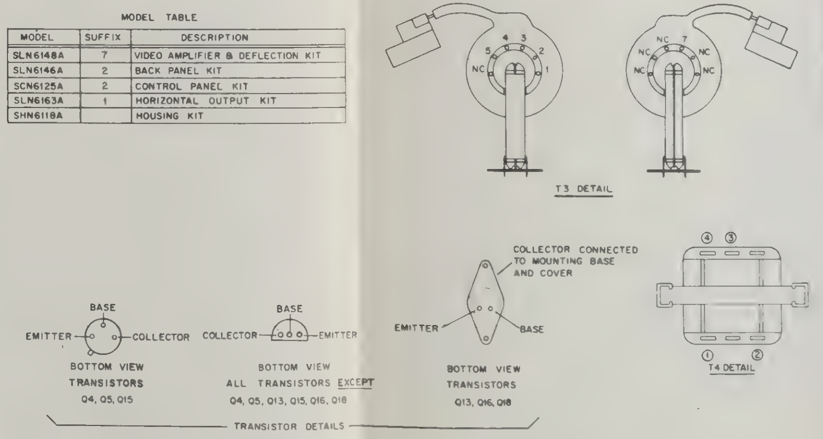
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
SLN6148A	7	VIDEO AMPLIFIER & DEFLECTION KIT
SLN6146A	2	BACK PANEL KIT
SCN6125A	2	CONTROL PANEL KIT
SLN6163A	1	HORIZONTAL OUTPUT KIT
SHN6118A		HOUSING KIT

63E81051A99-C



NOTES

1. UNLESS OTHERWISE STATED
   ALL RESISTOR VALUES ARE ±10%, 1/2 WATT
   ALL CAPACITOR VALUES ARE IN MICROFARADS
2. DIRECTION ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION
3. R15, C7 AND C8 ARE SELECTED TO COMPENSATE FOR LOSSES IN LONG COAXIAL CABLE RUNS FROM CAMERA TO MONITOR. TO INSERT THE PROPER NETWORK, MOVE JUMPER PLUG P2 INTO THE CORRECT TERMINAL ON THE BOARD
4. INDUCTOR AND TRANSFORMER RESISTANCES LESS THAN 1 OHM NOT SHOWN
5. CATHODE VOLTAGE WILL VARY WITH SETTING OF BRIGHTNESS AND CONTRAST

MODEL TABLE

MODEL	SUFFIX
SLN6146A	2
SLN6148A	4
SLN6163A	1
SCN6125A	1

FOR MODELS SUFFIXED EARLIER THAN INDICATED IN THE ABOVE TABLE, REFER TO SCHEMATIC DIAGRAM 63E81039A26.

EPD-18023-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

CCTV Video Monitor
Schematic Diagram
Motorola No. 63E81051A99-C
5/7/68-UP

RENCE BOL	MOTOROLA PART NO.	DESCRIPTION

A Horizontal Output Kit EPD-18029-O

	6S6462	RESISTOR, fixed: 47K ±10%; 1 w
	24D83600C02	TRANSFORMER, horizontal output
	95R354A01	ELECTRON TUBE: type 3AT2
	9B83601C01	SOCKET, tube: duo decar; does not incl. 14C83945B01 INSULATOR
NON-REFERENCED ITEMS		
	42K754321	CONNECTOR, picture tube anode
	1V80757A61	HIGH VOLTAGE SHIELD ASS'Y

A Housing Kit EPD-18030-O

		COIL, picture tube deflection: (p/o 1V80757A59; see non-referenced items)
	96R138A01	ELECTRON TUBE: cathode ray; type 19EBP4
NON-REFERENCED ITEMS		
	1V80757A59	DEFLECTION YOKE ASS'Y; incl. windings L3, L7
	30B82953E01	CABLE ASS'Y: incl. picture tube socket
	15D83594C01	CABINET
	42A83882C01	GROUNDING STRAP (for picture tube)
	75A82394C01	FOOT, cabinet: 4 req'd
	15C83597C01	COVER (for controls)
	13C83171C01	BEZEL (19")
	13D83130C01	MASK (for picture tube)
	55B83598C01	LOCK: incl. 2 keys and mtg hardware
	2C82360B11	SPEED NUT: 12 req'd

lacement diodes and transistors must be ordered by
orola part number only for optimum performance.

ACCESSORY ITEMS

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
A	SLN6148A-5	R29	WAS 6S6074, 68K	V1-G1	PEPD-18021
		R60	WAS 6S6320, 10K	T1	
		[illegible]	WAS [illegible], 22	Q[illegible] COL-LECTOR	
		Q[illegible]	[illegible], TYPE [illegible]	HORIZ. OSC.	
		R113	ADDED	V1-G3	
		R114	ADDED	V1-G2	
		R115	ADDED	V1-K	
B	SLN6148A-6	C33	WAS 8D82905G23, .02; 100 V REPLACED BY [illegible]	Q14 COL-LECTOR	PEPD-18021
		R76	WAS 6S6090, 470	Q14 EMIT-TER	
		R78	6S6320, 10K RE-MOVED	Q15 BASE	
		[illegible]	WAS [illegible]	Q16 BASE	
		L6	[illegible] MH CHOKE RE-MOVED		
		[illegible]	[illegible], 22, ADDED	Q14 COL-LECTOR	
		R117	6S6022, 330 ADDED	Q16 COL-LECTOR	
[illegible]	SCN6125A-2	R70	WAS 18K82515B37, 5K	BELOW Q13	NONE
		[illegible]	WAS 6S5659, 3.9K		PEPD-18021
		R69	WAS 6S2079, 6.8K		
		[illegible]	WAS 6S6393, 1.2K		

PARTS LIST

SLN6148A Video Amplifier & Deflection Kit — EPD-18026-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf; ±10%; unl. stated
C1	23D82077C18	600; 25 v
C2, 6, 7	23D82013C01	15 +100-10%; 25 v
C3, 14	23D82601A31	15 +150-10%; 25 v
C4, 13	8K859592	1 ±20%; 100 v
C5, 7B	21K859942	220 uuf ±5%; 300 v
C7A	21K840047	150 uuf ±5%; 500 v
C7C, 8D	21K859944	300 uuf ±5%; 300 v
C7D, 8E	21K859945	390 uuf ±5%; 300 v
C7E, 8F	21D82537B06	470 uuf ±5%; 300 v
C7F	21K863948	565 uuf ±5%; 500 v
C7G, 8G	21K848236	650 uuf ±5%; 300 v
C8	23D82601A05	50 +150-10%; 25 v
C8A	21K873266	68 uuf ±2%; 500 v
C8B	21K865443	140 uuf ±3%; 500 v
C8C	21K865440	180 uuf ±3%; 500 v
C9	21D82537B22	560 uuf ±5%; 100 v
C10	8K863305	2; 200 v
C11, 42	8C82095G08	0.1; 400 v
C12	23D82601A14	5 +100-10%; 250 v
C15, 25, 26	8D82905G26	.0047; 100 v
C16, 27	8D82905G01	.01; 50 v
C17	8C82284C12	.047; 50 v
C18	8K847105	.01; 400 v
C19	8D82905G23	.02; 100 v
C20, 21	23D82783B27	10; 25 v
C22, 47	21D82428B22	.01 ±20%; 1000 v
C23	8K868503	.047; 400 v
C24	8D82905G16	.033; 100 v
C28	8D82905G14	.01; 100 v
C29	8D82905G12	0.15; 50 v
C30	8D82396B02	.05; 200 v
C31	8C82284C15	0.1 ±5%; 50 v
C32	8K868593	.082; 100 v
C34, 51	23C82077C01	100 +150-10%; 35 v
C35, 36	23D82601A12	100 +150-10%; 6 v
C37	21D82428B28	.002; 200 v
C38, 41	21C82164B01	.01; 1000 v
C39	8B83300D01	1; 600 v
C40	8D82665G02	0.47; 200 v
C43	8K83894	.01; 600 v
C44	8C82927C04	0.47; 200 v
C45	8K865917	0.1; 400 v
C46	23C82341B01	60 +100-10%; 150 v
C48, 49, 50	23D82394A09	300 +100-10%; 150 v
C52	23C82601A10	16 +33-10%; 10 v
C53	21D82428B57	.0033; 200 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 8	48C82420C10	silicon
CR2	48C82420C01	silicon
CR3	48K863030	germanium
CR4, 5	48C82392B03	silicon
CR6, 7	48C82466H25	silicon
CR9	48C82466H17	silicon
CR10, 11, 12, 13	48C82525G06	silicon
CR14	48D82256C42	silicon; zener type
CR15	48D82256C12	silicon; zener type
		FUSE, cartridge:
F2	65S42092	2 amp; 250 v
F3	65K892099	3/4 amp; 125 v; slow-blow type
		COIL, RF:
L1	24D82480B04	choke; 25 uh
L2	24D82480B02	choke; 16 uh
L3	24D82480B01	choke; 67.6 uh
L5	24V80905A05	incl. 1A82354B07 CORE, tuning
L8	24D67324A30	choke; 3.6 mh
L9	25C83605C01	choke; 10 mh
		TRANSISTOR: (SEE NOTE)
Q1, 15	48R869339	P-N-P; type M9339
Q2, 5	48R869340	N-P-N; type M9340
Q3, 4, 6, 8 10, 18, 19	48R869338	N-P-N; type M9338
Q7, 12, 13, 16, 20	48S134843	N-P-N; type M4843 or M9340
Q9, 14	48S134842	N-P-N; type M4842

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		RESISTOR, fixed: ±10%; 1/2 w; unl. stated
R1	6S5732	15K; 2 w
R2	6S410020	75 ±5%
R3	6S6069	2.2K
R4, 36, 57, 88, 97	6S6117	5.6K
R5, 87	6S6048	47K
R6, 16, 15A, 53	6S6038	1.5K
R7, 24	6S6373	150
R9, 40	6S5550	47
R10, 33, 63	6S6410	33K
R11, 21, 54	6S6428	6.8K
R12, 19, 116	6S6270	220
R13, 15, 80	6S6090	470
R14, 38, 59	6S5581	3.3K
R15B, 75, 102	6S6393	1.2K
R15C, 15D, 76 15E, 15F, 15G, 40, 48, 64, 65, 115	6S6229	1K
R17, 39	6S2004	8.2K
R18, 35, 42, 66, 67, 68, 113	6S6320	10K
R20, 50	6S6269	820
R22, 94	6S6031	100K
R23, 52, 77	6S5551	120
R25, 71	6S5577	2.7K
R26	6S2029	3.3K; 2 w
R27	6S6446	4.7 meg
R28, 60	6S6434	27K
R29, 114	6S5631	120K
R30, 61	6S6394	12K
R32	6S6475	680K
R34	6S5646	390K
R37	6S6406	22
R43	6S6487	39K
R44, 49, 73, 99, 100, 101, 103	6S6397	22K
R45	6S6398	150K
R47	18C82943G02	var; 500 ±20%; 2 w
R51, 74, 104	6S6326	100
R55	17K892227	8.2 ±5%
R56	18C82943G05	var; 50 ±20%; 2 w
R58, 62	6S5659	3.9K
R69	6S118241	150K, 2 w
R72	17C82291B27	5.6K; 5 w
R79	6S6432	270
R81	6S2030	12
R82	17C82291B33	1.2K; 5 w
R83	17A890466	1.5
R84	6S5697	560K
R85	6S6414	270K
R86	6S6377	470K
R89	6S5764	2.7K; 2 w
R90	17C82291B26	750; 5 w
R91	17K868696	10; 5 w
R92	6S476116	270; 2 w
R95	17C82291B32	900 ±5%; 5 w
R96	6S6479	68K ±5%
R98	18C82943G06	var; 1.5K ±20%; 2 w
R105	6S6477	15K
R106	17C82291B17	1K; 5 w
R107	6S6389	220; 1 w
R108, 109	17C82291B31	1.2K ±5%; 3 w
R110	17C82291B06	15; 5 w
R112	6S6407	220K
R117	6S6022	330
		VARISTOR:
RV1	6C66263A08	1 ma @ 120 v dc
		SWITCH, slide:
S1, 2, 4	40C83608C01	dpdt
		SPARK GAP:
SG1, 2	80C82189F01	1 kv
		TRANSFORMER:
T1	25D83355D01	vert. output; pri: RED, YEL; res. 28 ohms sec: GRN, BLK; res. 5 ohms
T2	25C83607C01	horiz. driver; pri: 3.8 ohms ±20%; sec: .072 ohms ±20%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEM		
	26B82185F01	HEAT SINK

SLN6146A Back Panel Kit — EPD-18027-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle: female;
J101, 102	9K864732	single cont.
J103	9A801241	4 cont.
		CONNECTOR, plug:
P101		male; 2 cont. (p/o W1)
		TRANSISTOR: (SEE NOTE)
Q11	48R869408	N-P-N; type M9408
Q17	48R869337	N-P-N; type M9337
Q21	48R869336	P-N-P; type M9336
		RESISTOR, fixed:
R71	17C83620C01	100 ±10%; 30 w
		TRANSFORMER, power:
T2	25D83619C01	pri: BLK. BLK; res 3.5 ohms sec No. 1: RED, RED; res 1.9 ohms sec. No. 2: GRN, GRN: res 0.25 ohms
		CABLE ASSEMBLY, power:
W1	30C865903	3 cond; each cond No. 18 ga.; str; 8' long overall; incl. "molded-on" 3-cont. male plug (P1)
		SOCKET, transistor:
XQ11, 17, 21	9D82673A01	female; 2 cont.
NON-REFERENCED ITEM		
	14K865875	INSULATOR, transistor mtg (used with Q13, 16, 18)

SCN6125A Control Panel Kit — EPD-18028-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		FUSE, cartridge: 1-1/4" x 1/4"
F1	65K817955	slow-blow type; 3 a; 125 v
		RESISTOR, variable: ±30% unl. stated
R8	18D82515B40	750; ±10%; 1/2 w
R31	18D82515B21	50K; 0.33 w
R46	18D82515B39	100K; 0.33 w
R70	18K82515B17	10K; 1/2 w
		SWITCH, toggle:
S3	40K811752	dpdt
		FUSEHOLDER:
XF1	9B82080G01	extractor post type
NON-REFERENCED ITEMS		
	15B83583C01	COVER, panel
	36B82629H01	KNOB, control; 4 req'd

SLN616[illegible]A Horizontal Output Kit — EPD-18029-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		RESISTOR, fixed:
R93	6S6462	47K ±10%; 1 w
		TRANSFORMER,
T3	24D83600C02	horizontal output
		ELECTRON TUBE:
V2	95R354A01	type 3AT2
		SOCKET, tube:
XV2	9B83601C01	duo decar; does not incl. 14C83945B01 INSULATOR
NON-REFERENCED ITEMS		
	42K754321	CONNECTOR, picture tube anode
	1V80757A61	HIGH VOLTAGE SHIELD ASS'Y

SHN611[illegible]A Housing Kit — EPD-18030-O

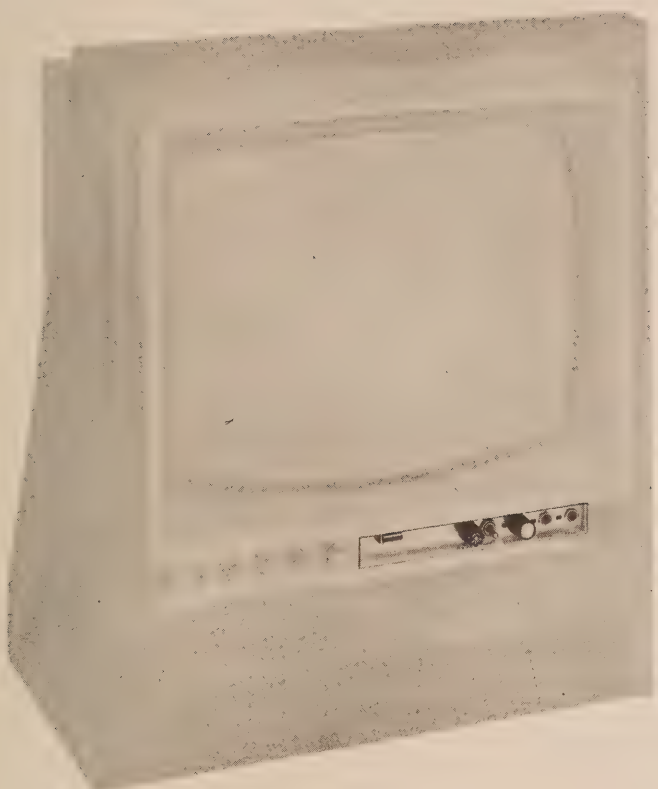
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		COIL, picture tube deflection:
L4, 8		(p/o 1V80757A59; see non-referenced items)
		ELECTRON TUBE:
V1	96R138A01	cathode ray; type 19EBP4
NON-REFERENCED ITEMS		
	1V80757A59	DEFLECTION YOKE ASS'Y: incl. windings L3, L7
	30B82953E01	CABLE ASS'Y: incl. picture tube socket
	15D83594C01	CABINET
	42A83882C01	GROUNDING STRAP (for picture tube)
	75A82394C01	FOOT, cabinet: 4 req'd
	15C83597C01	COVER (for controls)
	13C83171C01	BEZEL (19")
	13D83130C01	MASK (for picture tube)
	55B83598C01	LOCK: incl. 2 keys and mtg hardware
	2C82360B11	SPEED NUT: 12 req'd

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

ACCESSORY ITEMS

CAMERA CONTROL PANEL AND JUNCTION BOX



MODEL TABLE

MODEL	DESCRIPTION
SCN6124A	Camera Control Panel
SLN6156A	Junction Box

1. DESCRIPTION

This panel is used to control Motorola transistorized Television Camera Models S1120C, S1121C and S1122C. It is mounted on the control panel of a Motorola Model S1219A Video Monitor.

A control cable passes from the monitor to a Model SLN6156A Junction Box (supplied with camera) mounted on the rear of the camera.

The camera control kit provides five control facilities for operation of the camera. These are as follows:

a. The ON-OFF switch applies 117 v a-c, 60-cycle line voltage to the camera.

b. The FOCUS control adjusts the electrical focus of the camera vidicon tube.

c. The BEAM control adjusts the camera vidicon tube beam current.

d. The automatic-manual (AUTO-MAN) switch selects the mode of vidicon target voltage adjustment (sensitivity). In the automatic (AUTO) position, target voltage is automatically adjusted by camera circuits. In the manual (MAN) position, target voltage is manually adjusted by the SENSITIVITY control.

e. The SENSITIVITY control adjusts the vidicon target voltage when the automatic-manual (AUTO-MAN) switch is in the manual (MAN) position.

NOTE

This panel has a combined control for the SENSITIVITY and the automatic-manual (AUTO-MAN) functions. The SENSITIVITY control knob is pulled out and rotated for the manual mode of sensitivity adjustment. The knob is pushed in for the automatic mode.

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Issue - B

Refer to the camera instruction manual for the proper setting of these controls.

2. INSTALLATION

a. Model SCN6124A Camera Control Panel

Remove the blank plate on the monitor control panel and replace with the camera control panel. Fasten the camera control chassis to the bottom of the monitor cabinet using three screws (supplied). Insert the plug extending from the chassis into the auxiliary power receptacle on the monitor chassis flange.

The monitor chassis terminal board is connected by control cable to a similar terminal board within the Model SLN6156A Junction Box at the camera site. A one-to-one relationship exists between the junction box terminal board and the monitor chassis terminal board.

The selection of a cable for control of camera functions must be given careful consideration. A good installation requires the use of well insulated wires usually with an overall cable shield. The outer jacket should be of a tough, durable plastic, able to withstand abrasion, weather and corrosive fumes or agents which may be present. The size of the conductors will depend on the distance the control cable must run. However, if the wire sizes shown in the cabling diagram are used, no difficulties should be encountered. The control cable should be passed through the cable gland fitting that is located in the plug button-covered hole on the left rear monitor panel as shown in the Cable Gland Fitting Detail. Connect the colored leads of the cable to the same terminal numbers at both ends. Refer to the Inter-Unit Cabling Diagram for details.

b. Model SLN6156A Junction Box

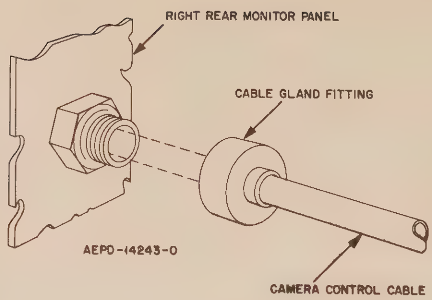
When connecting the control cable to the SLN6156A Junction Box and installing the junction box on the camera, proceed as follows:

(1) Remove the junction box cover by taking out the two screws (one on each side) which attach it to the mounting bracket.

(2) Place the large rubber grommet (which can be easily slid from the cover) over the control cable which goes to the camera control unit.

(3) Clamp the control cable to junction box bracket by means of cable clamp provided.

(4) Attach leads to appropriate terminals of terminal board. Spade lugs should be used on the end of the leads.



Cable Gland Fitting Detail

(5) When a zoom lens is used, the cable from the lens must be run through the small grommeted hole in the cover before the cable is attached to the terminal board.

(6) A lead from the zoom lens together with a lead from the control cable are attached together under one terminal lug.

(7) The colors of the leads connected to the terminals should be recorded on the label provided in the cover. Should it be required to disconnect the camera at a later date, the label in the cover will facilitate reconnection.

(8) Plug the connector of the junction unit into the camera, and with the two screws provided, fasten it to the camera.

(9) Place cover in position and fasten with its screws.

For removal of the junction box and control cable, follow the installation procedure in reverse order. For removal of the camera only, the leads do not have to be removed. Proceed as follows:

(1) Remove cover by removing two screws fastening it to the mounting bracket.

(2) Lift cover and slide along the cable to the zoom lens.

(3) Remove two screws securing junction box mounting bracket to camera.

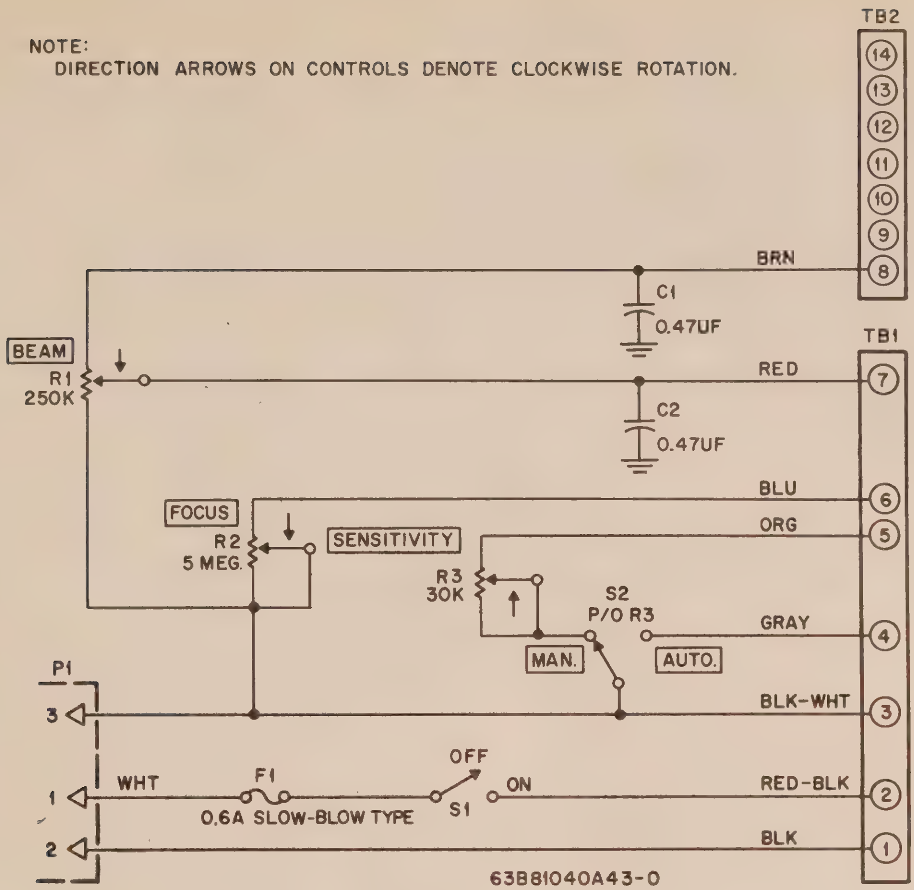
(4) Unplug junction unit from camera.

(5) Remove zoom lens from camera.

3. MAINTENANCE

Maintenance of these control facilities consists of keeping the unit clean and connections tight.

Malfunction of the control facilities can normally be attributed to lack of power. Use the schematic diagrams in this instruction section to locate the circuits at fault. In most instances, troubles can be isolated by using only a voltmeter.

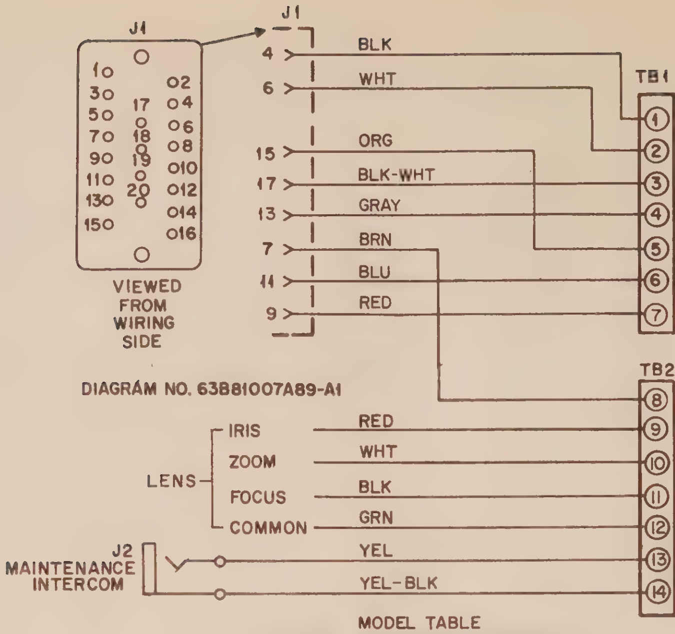


PARTS LIST for Schematic Diagram 63B81040A43-O

SCN6124A Control Panel

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1, 2	8K863994	0.47 uf ±10%; 200 v
		FUSE, cartridge:
F1	65K817953	slow blow type; 0.6 a; 125 v; 1-1/4" x 1/4"
		CONNECTOR, plug:
P1	28A898881	male; 4 cont.
		RESISTOR, variable:
R1	18D82515B15	250K ±20%; 0.25 w
R2	18D82515B16	5 meg ±30%; 0.12 w
R3	18D82485D01	30K ±20%; 0.16 w; incl. two (2) spst plunger action switches (see S2)
		SWITCH,
S1	40A482097	toggle: spst
S2		(part of R3) NOTE: Consists of two (2) plunger action switches mounted on control R3. One switch spst, normally open. Other switch spst, normally closed.
		BOARD, terminal:
TB1	31B82573C04	terminals coded 1 thru 7
TB2	31B82573C05	terminals coded 8 thru 14
		FUSEHOLDER:
XF1	9C82083C01	extractor post type

Model SCN6124A
Camera Control Panel
Schematic Diagram
Motorola No. 63B81040A43-O
1/21/66-UP



MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
SLN6156A		JUNCTION BOX

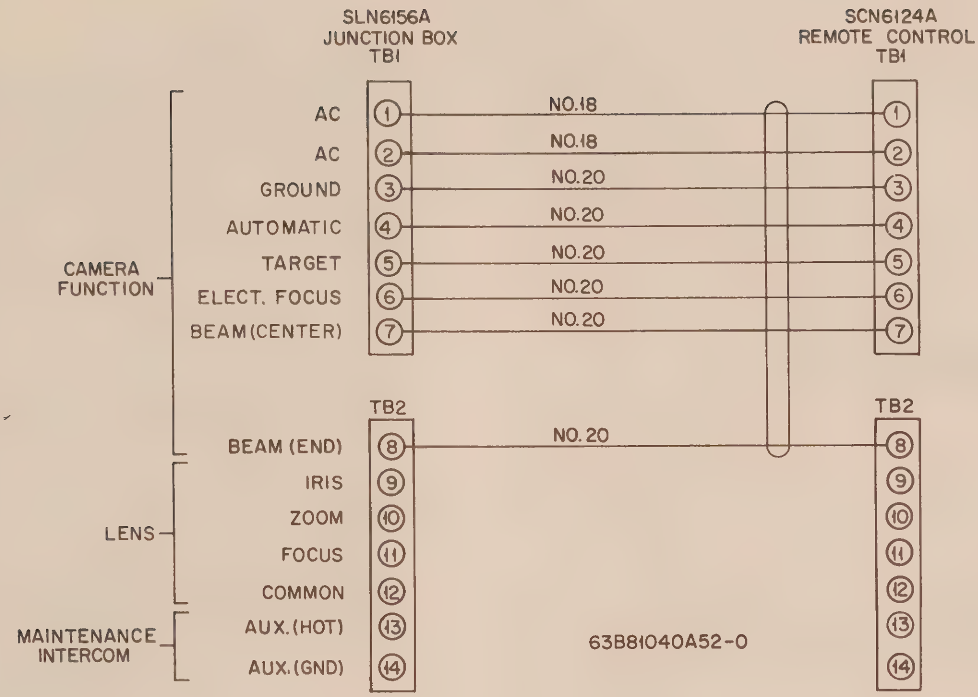
REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
O1	SLN6156A	J2	CONNECTOR AND ASSOCIATED WIRING REMOVED	
A	SLN6156A	J2	WAS 9A801241	PARTS LIST
		TB1	WAS 31B890699	
		TB2	WAS 31B82573C02	
A1	SLN6156A		ADDED NON-REFERENCED ITEMS	PARTS LIST

PARTS LIST for diagram 63B81007A89-A1

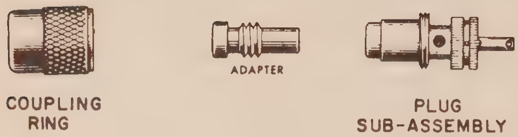
SLN6156A Junction Box

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<u>BOARD, terminal:</u>
TB1	31B82573C04	terminals coded 1 thru 7
TB2	31B82573C05	terminals coded 8 thru 13
		<u>CONNECTOR, receptacle:</u>
J1	9B82381D01	female; 20 contacts
J2	9B20261	male; 4 contacts
NON-REFERENCED ITEMS		
	32A82474G01	GASKET, strip; 14"
	5A483208	GROMMET
	3S121617	SCREW, machine; 4-40 x 1-1/4" "Phillips" round; 2 req'd
	4S400385	LOCKWASHER (#4spt MD) 2 req'd
	42K480469	CLAMP, (9/16")
	42K802007	CLAMP, (3/8")

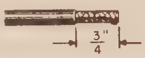


Inter-Unit Cabling Diagram
Motorola No. 63B81040A52-O
1/21/66-UP

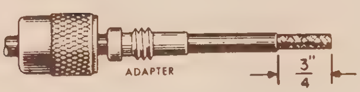
Step (1) Disassemble the connector plug.



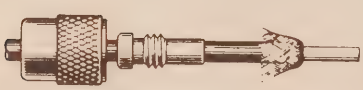
Step (2) Cut off end of cable squarely. Remove 3/4" of vinyl jacket.



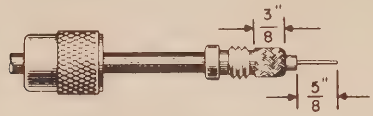
Step (3) Slide coupling ring and adapter on cable.



Step (4) Fan braid slightly and fold back as shown.



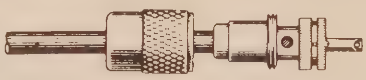
Step (5) Position adapter to dimension shown. Press braid back over body of adapter and trim to 3/8". Bare 5/8" of conductor. Tin exposed center conductor.



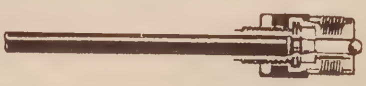
Step (6) Screw adapter into body of plug sub-assembly. Solder braid to body of plug sub-assembly through holes. Solder center conductor of cable to plug contact of plug sub-assembly.

CAUTION

Use very hot iron. Solder quickly and chill immediately with cold, wet cloth. DO NOT USE EXCESSIVE HEAT OR SOLDER.



Step (7) For final assembly, screw coupling ring on plug sub-assembly.



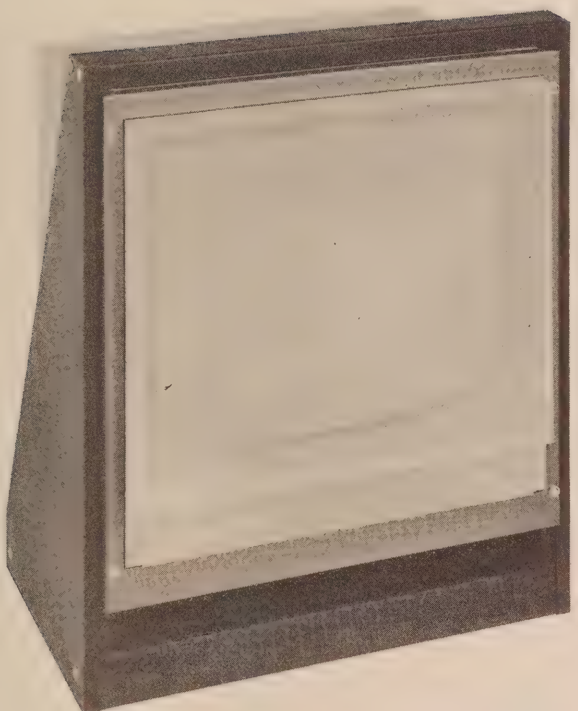
BEPD-12830-O

UHF Connector
Installation Detail
Motorola No. AEPD-20957-O
5/7/68-UP

MOTOROLA

MONITOR RACK-MOUNT ADAPTER

MODEL SLN6149A



1. DESCRIPTION

This rack-mount adapter is used to mount the Model S1219A Video Monitor in a rack.

2. INSTALLATION

Refer to the mounting detail and follow these steps:

a. Assemble the threaded bushings to the shelf.

b. Mount the shelf to the rack.

c. Assemble the right and left hand brackets to the shelf and rack.

d. Locate the proper position for the four speed nuts and snap them on the rack flange.

e. Mount the monitor on the shelf and make sure the threaded bushings fit into the holes at the bottom of the monitor front mounting feet.

f. Slip the panel cover over the monitor and fasten it to the rack.

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68P81040A44
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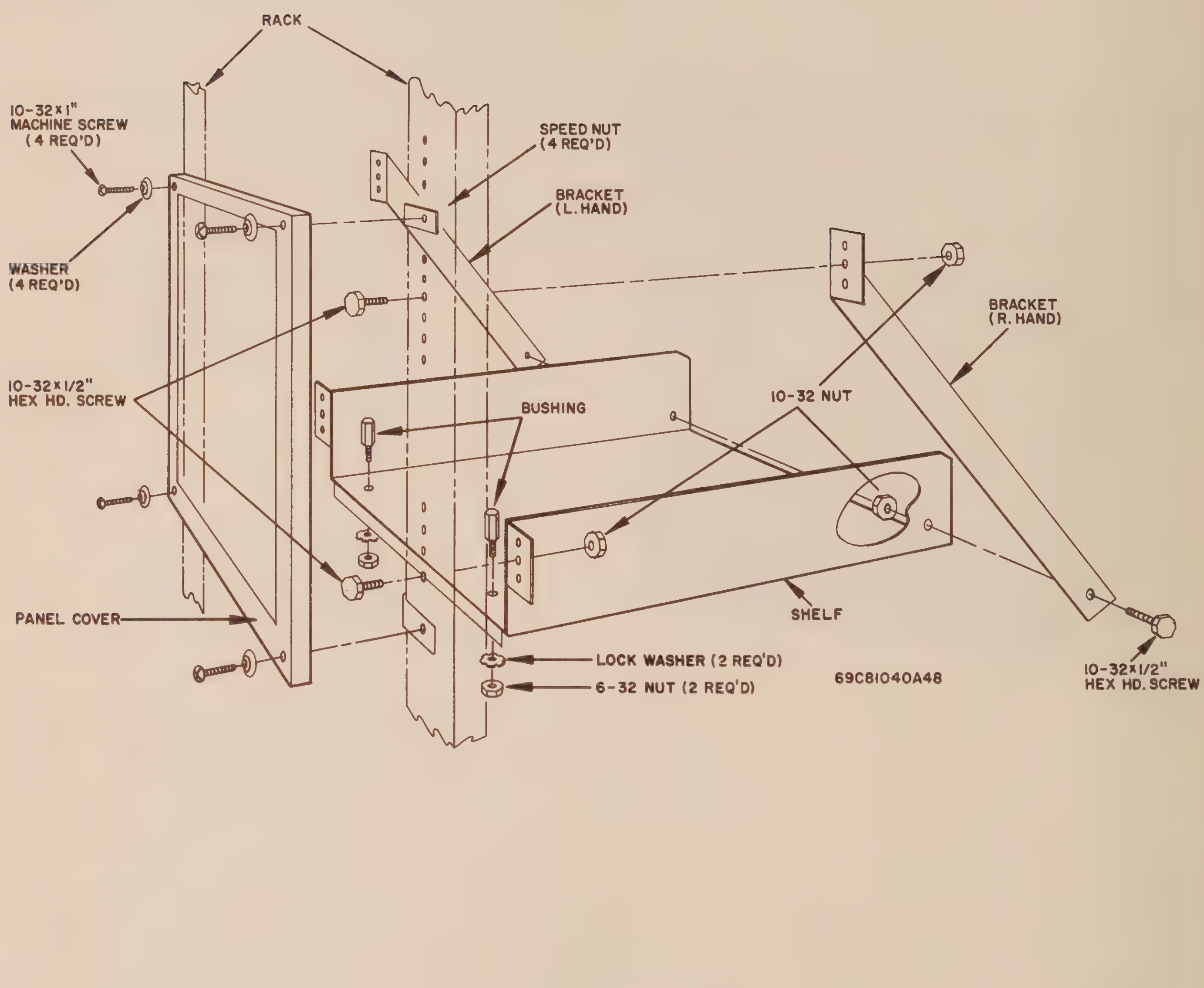
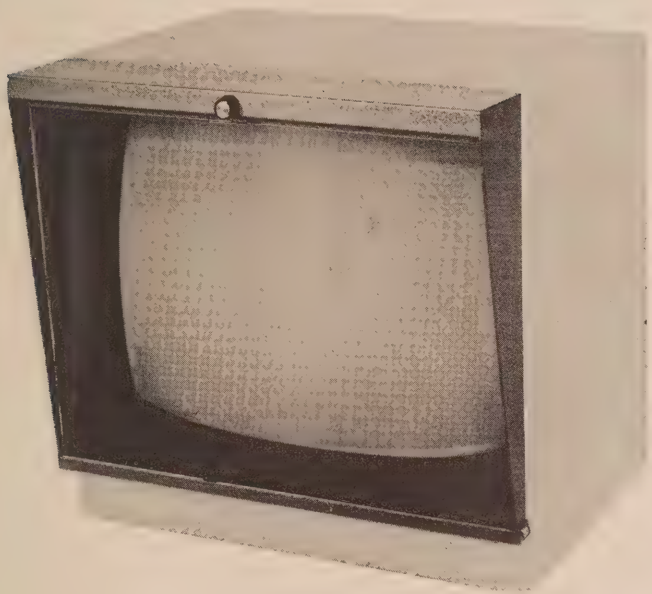


Model SLN6149A Rack-Mount Adapter
Mounting Detail
Motorola No. 69C81040A48-O
1/21/66-UP

MOTOROLA

MONITOR POLARIZED GLASS

MODEL SLN6162A



1. DESCRIPTION

This monitor polarized glass is used to reduce glare or reflections present on the face of the Model S1219A Video Monitor.

2. MODEL COMPLEMENT

The monitor polarized glass consists of the the following items:

MOTOROLA PART NO.	DESCRIPTION
15D83733C01	HOOD
7B83730C01	SILL, hood
7B83731C01	BRACKET, glass mounting (front)
7B83732C01	BRACKET, glass mounting (rear)
32B82642C03	GASKET, window trim
61B83729C01	WINDOW (19") polarized glass
41B83819C01	SPRING: 2 req'd
36B82629H01	KNOB, tilt control

3. INSTALLATION

a. Clean the picture tube faceplate with a soft clean cloth.

b. Place the rear flange of the polarized glass into the grooves of the monitor bezel and slide the unit down over the front of the monitor.

c. Adjust the glass tilt for minimum surface reflection by rotating the adjusting knob located on the front of the unit.

4. MAINTENANCE

a. To clean the inside surface of the polarized glass and the front of the picture tube, remove the entire unit from the monitor by lifting it vertically along the bezel grooves.

b. Wipe the surfaces with a soft clean cloth using a commercial window cleaner.

c. Re-install the assembly as previously described.

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68P81040A49
Issue - O

CCTV

MOTOROLA *closed circuit television • transistorized gate-watch control consoles*

MOTOROLA INC., COMMUNICATIONS DIVISION · **INSTRUCTION MANUAL**

68P81054A70-A

MOTOROLA

MODEL S1239A

GATE-WATCH CONTROL CONSOLE

117 VAC

MOTOROLA INC. Communications Division

ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

2/28/68-UP

68P81054A70
Issue - A

SPECIFICATIONS

INTERCOM AMPLIFIER

MAXIMUM POWER INPUT	40 watts at 117 volts ac 50/60 cycles
POWER SUPPLY LOAD	50 ma at 24 volts dc (zero signal) 570 ma at 24 volts dc (full load--5 watts audio output)
FREQUENCY RESPONSE (1 kc ref)	200-5000 cps ±1 db
INPUT IMPEDANCE	600 ohm (balanced)
OUTPUT IMPEDANCE	600 ohm (balanced)
SIGNAL INPUT FOR 5 WATTS OUTPUT	3.2 millivolts base drive (nominal gain 80 db)
OPERATING TEMPERATURE RANGE	-30°C to +60°C

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CONTENTS

DESCRIPTION

1. GENERAL

The Model S1239A Gate-Watch Control Console is a combination audio intercom and remote control unit for use in a closed circuit television system (CCTV). It can be used for controlling operation of a Motorola CCTV camera, floodlights, gates, etc. located up to 3000 feet from the operator. Following is a table listing the console dimensions:

	DEPTH	WIDTH	HEIGHT	WEIGHT
BASIC UNIT	18.5"	15"	4.25"	20.25 lbs
WITH RACK MTG. KIT	18.75"	19"	5.22"	26.25 lbs

2. MODEL COMPLEMENT

The Model S1239A Gate-Watch Control Console consists of a Model SLN6174A Gate-Watch Chassis mounted in a rectangular metal housing (Model SHN6115A). The operating control functions are as follows:

a. The Power ON-OFF Switch--applies operating power to the control console.

b. The OFF-MAN(ual)-AUTO(matic) Switch----applies operating power to the remotely located camera when placed in either the MANual or AUTO position. In the AUTO position, camera target voltage is adjusted automatically as light conditions change at the camera location.

c. The TARGET Control--is a potentiometer used to adjust the vidicon target voltage to compensate for extreme lighting conditions at the camera location. It operates in the camera circuitry only when the OFF-MAN-AUTO switch is placed in the MAN position.

d. The CAMERA FOCUS Control--is a potentiometer used to adjust the electrical focus of the camera vidicon tube. The control is located on the rear panel of the console.

e. The CAMERA BEAM Control--is a potentiometer used to adjust the camera vidicon tube beam current. The control is located on the rear panel of the console.

f. The GATE OPEN-CLOSE Switch--is a momentary contact switch used to actuate a gate opening or closure at a remote location.

g. The GATE STOP Switch--interrupts and stops the motion of the gate at any time during its operation cycle.

It is a momentary action, pushbutton switch with standard "C" contact arrangement. It may be used as a normally open or a normally closed switch.

h. The LIGHTS ON-OFF Switch--is used to turn lights on or off at the camera location.

i. The INTERCOM VOLUME Control--is used to adjust the incoming audio level from a remotely located speaker/microphone unit to compensate for varying ambient noise levels at the gate-watch control console location.

j. The INTERCOM TRANSMIT LOCK-RECEIVE-TRANSMIT Switch--is used to select transmit or receive operation of the intercom facility at the control console location.

The TRANSMIT position is a momentary contact type and is used for short transmissions to the remote location. The switch must be held in this position until transmission is completed. Upon release, the switch automatically returns to the RECEIVE position.

For long transmissions, the switch is placed in the TRANSMIT LOCK position. This position is self-locking and the switch must be returned to the RECEIVE position manually upon completion of the transmission.

k. The AUX Jack---may be used to connect a sound-powered device for maintenance communication with the remote location. The jack is located on the rear panel of the console.

3. ACCESSORY ITEMS

The following accessory items (not part of Model S1239A Gate-Watch Console) are available on separate order for use with the Model S1239A. Instructions are packed and shipped with the items.

a. The SLN6137A Rack-Mount Adapter Kit---may be used with the gate-watch control console if rack mounting is desired.

b. The SLN6138A Outdoor Speaker/Microphone--is used for installation at the remotely controlled location for intercommunication with the control console location.

c. The SKN6114A Control Cable -- available in lengths up to 3000 feet. Is used for interconnection of the control console and the SLN6139B Weatherproof Junction Box.

d. The SLN6139B Weatherproof Junction Box ---available for distribution of control cables to the remotely controlled equipment.

INSTALLATION & OPERATION

1. CONSOLE MOUNTING

a. Desk Top or Shelf

Select a convenient location for the control console. The basic unit is used for desk-top or shelf mounting and has rubber pads to prevent surface marring. The unit may be used as a pedestal for a Motorola 14-inch monitor.

b. Rack Mounting

A rack mounting kit (accessory item) is also available. Instructions for its use are packed with the kit (see listing of accessory items in DESCRIPTION section).

2. CONNECTIONS

The Model SKN6114A Control Cable (accessory item) is recommended for interconnection of the Gate-Watch Control Console and the remotely controlled units. Two screw-type terminal boards are located at the rear of the control console (accessible by removing snap-on back cover).

CAUTION

Do not connect power plug for control console to receptacle (117 v ac) until all other wiring is completed.

Terminals on these boards are numbered. The cable leads are color-coded and care should be taken to insure that the leads are connected to the terminal boards and remote equipment as shown on the System-Interconnection diagram.

A Model SLN6139B Junction Box (accessory item) is available for distribution of the control leads to the remote equipment. The box is weather resistant and suitable for mounting in exposed locations.

WARNING

To prevent shock hazards, the dust covers on both the control console and junction box must be replaced when wiring is completed.

3. PRELIMINARY ADJUSTMENTS

The intercom amplifier is factory adjusted for minimum distortion. For optimum performance in a particular ambient noise location, the GAIN control on the printed circuit board chassis may require readjustment (refer to Detail EPD-19300 for location). Place the transmit receive switch in the TRANSMIT LOCK position. Adjust the GAIN control until the sound received at the remote speaker/microphone location is clear and of sufficient level to overcome ambient noise. Place the switch in the RECEIVE position. With sound being received at the control console, from the speaker/microphone location, adjust the VOLUME control on the front panel for the desired listening level.

The BALANCE control located on the printed circuit board is factory adjusted and should NOT be readjusted except as stated in the MAINTENANCE section.

4. OPERATION

Refer to paragraph 2. in the DESCRIPTION section for a description of all operating controls and their functions. After the control cable installation is complete, the unit is placed in operation simply by plugging in the ac line cord and placing the power ON-OFF switch in the ON position.

THEORY OF OPERATION

1. CONTROLS

The functions and operation of the operating controls were previously described in paragraph 2 of the DESCRIPTION section. The FOCUS, BEAM and TARGET adjustments are more fully described in the camera instruction manual.

2. INTERCOM AMPLIFIER

This unit is a five-watt audio amplifier capable of high quality speech reproduction for line to speaker applications. The basic amplifier consists of five stages. Three RC coupled transistors (Q1, Q2 and Q3) are used for preamplification. These three transistors drive a transformer coupled driver (Q4) which, in turn, drives the push-pull output (Q5 and Q6). Feedback is employed in the preamplifier, driver and output stages to reduce distortion and improve regulation. The push-pull output is operated class AB with only a small amount of current flowing during the zero signal condition. Temperature sensitive resistors (RT1 and RT2) are used in the bias circuits of the driver and output stages to compensate for variations in transistor characteristics with temperature changes. A current balancing potentiometer (R25) is provided in the output stage for minimum distortion at full output.

When the transmit-receive switch is in the TRANSMIT or TRANSMIT LOCK position, the 8-ohm primary winding of the input transformer (T1) is connected to the voice coil of speaker LS1; the 600-ohm balanced winding is disconnected and the 600-ohm balanced secondary of the output transformer (T3) is connected to the transmission line going to the line matching transformer at the remote location. The VOLUME control center arm is disconnected from LS1.

When the transmit-receive switch is in the RECEIVE position, the 600-ohm balanced primary of the input transformer is connected to the lines from the remote location; the 8-ohm primary of T1 is disconnected and the VOLUME control center arm is connected to the voice coil of LS1.

NOTE

The transmit-receive switch merely switches the input and output of the amplifier between two speaker/microphones (control console and remote locations).

The regulated power supply provides full wave rectification with capacitive filtering. The regulator is a series type using the transistor to absorb voltage changes with a diode as a shunt element to control the output level. The transistor is used in an emitter follower configuration with the diode controlling the base. The supply is capable of delivering up to 570 ma at -24 v dc.

MAINTENANCE

1. GENERAL

Most maintenance can be performed using a voltmeter, an inexpensive oscilloscope and an audio oscillator. Refer to Detail EPD-19300. The amplifier can be considered as a series signal path and can by analyzed with a signal present.

2. BALANCE CONTROL

If transistors Q5 and/or Q6 must be replaced, a readjustment of the BALANCE control may be required. Two methods are given in the following paragraphs. The first method is a temporary or emergency procedure and the second is the recommended procedure.

a. <u>Temporary or Emergency Method</u>

(1) Place transmit-receive switch in RECEIVE position.

(2) With transmission being received from remote location, adjust BALANCE control for clear audio (free of distortion).

b. <u>Recommended Method</u> (Use whenever possible)

(1) Place transmit-receive switch in TRANSMIT LOCK position.

(2) Remove housing and snap-on dust cover at rear of console and disconnect the two BRN-RED leads from the printed circuit board solder terminals.

(3) Connect a 600-ohm output of an audio oscillator to the solder terminals disconnected in step (2).

(4) Disconnect the two external audio leads connected to the terminal board at the rear of the control unit. Connect a 600-ohm, 5-watt resistor across the same terminals.

(5) Connect an oscilloscope input across the 600-ohm resistor connected in step (4).

(6) Turn the control console and test equipment on and after allowing sufficient warm-up time for the test equipment, adjust the output frequency of the audio oscillator to 200 cps.

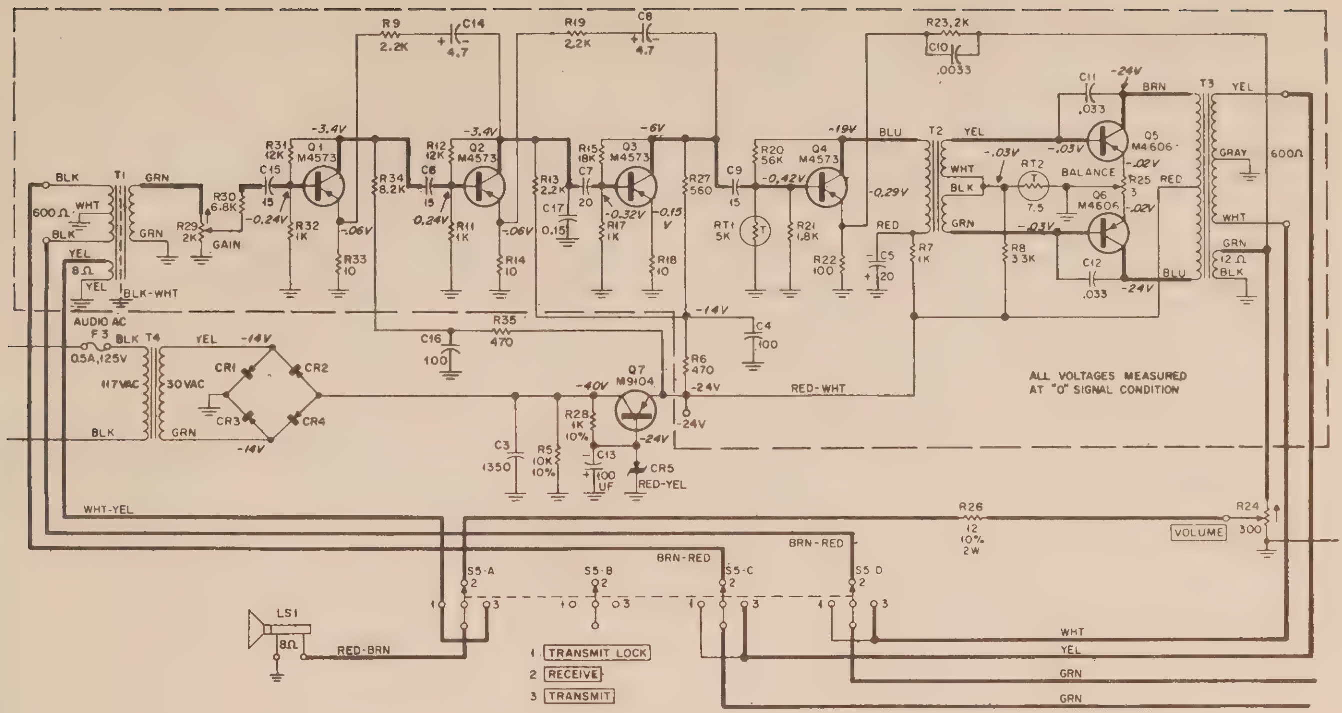
(7) Adjust the amplitude of the audio oscillator until no clipping (flattening of peaks) is observed on the oscilloscope.

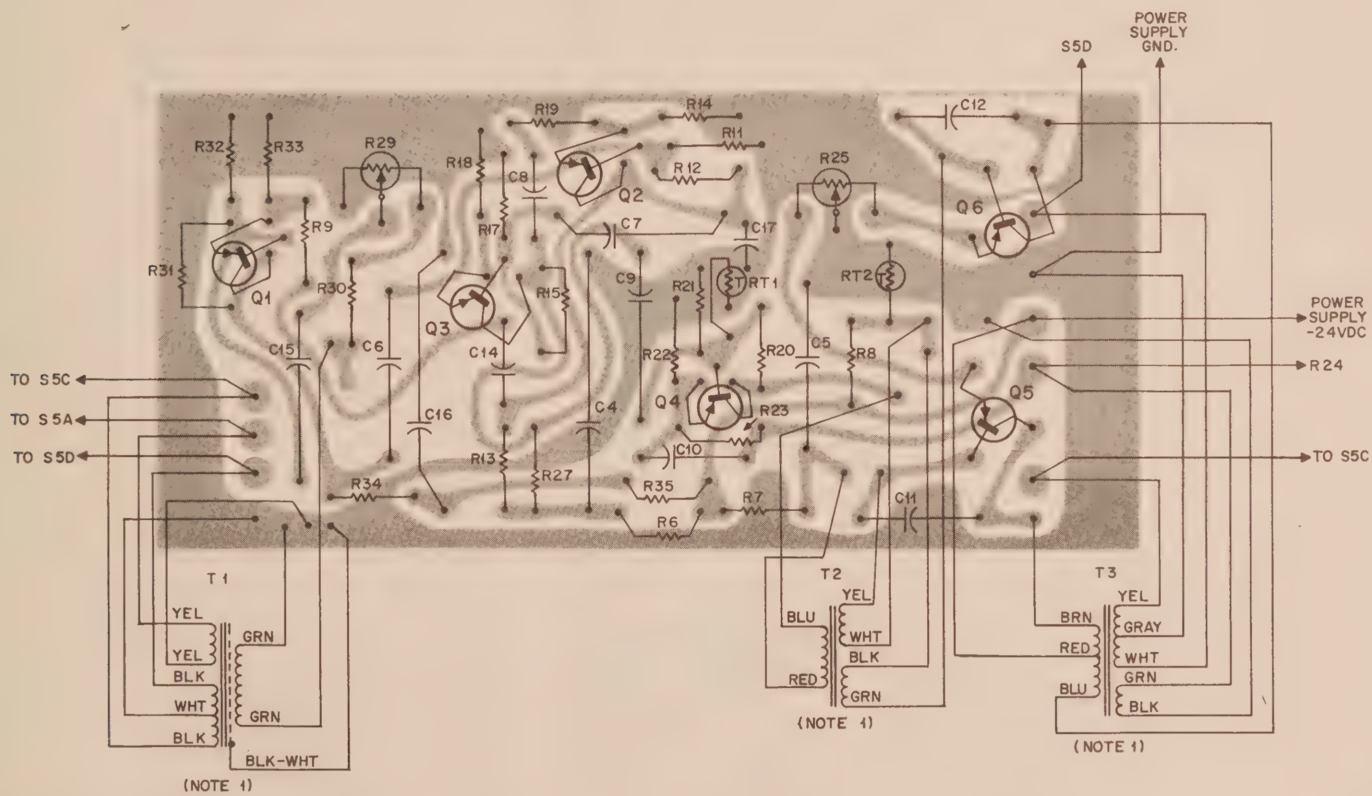
(8) Adjust the BALANCE control for a waveform with minimum distortion.

(9) Disconnect audio oscillator, oscilloscope and 600-ohm resistor.

(10) Reconnect the two BRN-RED and the two audio leads as originally connected.

(11) Replace housing and snap-on dust cover.





NOTES:

1. TRANSFORMERS T1,T2,T3 AND TRANSISTORS Q5,Q6 ARE NOT MOUNTED ON PRINTED CIRCUIT BOARD.
   FOR DC RESISTANCES OF TRANSFORMER WINDINGS, CONSULT PARTS LIST.
2. DOTTED PORTION DESIGNATES COMPONENTS LOCATED ON PRINTED CIRCUIT BOARD WITH EXCEPTIONS OF T1,T2,T3 AND Q5,Q6.
3. ALL DC VOLTAGES TAKEN DURING ZERO SIGNAL CONDITION.

OL-CEPD-19302-O

Audio Amplifier
Circuit Board Detail
Motorola No. PEPD-19300-O
6/30/67-UP

TES:

ALL RESISTOR VALUES ARE INDICATED IN OHMS, AND ARE ±5%, 1/2 WATT UNLESS OTHERWISE STATED. K = 1000 OHMS.

ALL CAPACITOR VALUES ARE IN MICRO-FARADS UNLESS OTHERWISE STATED.

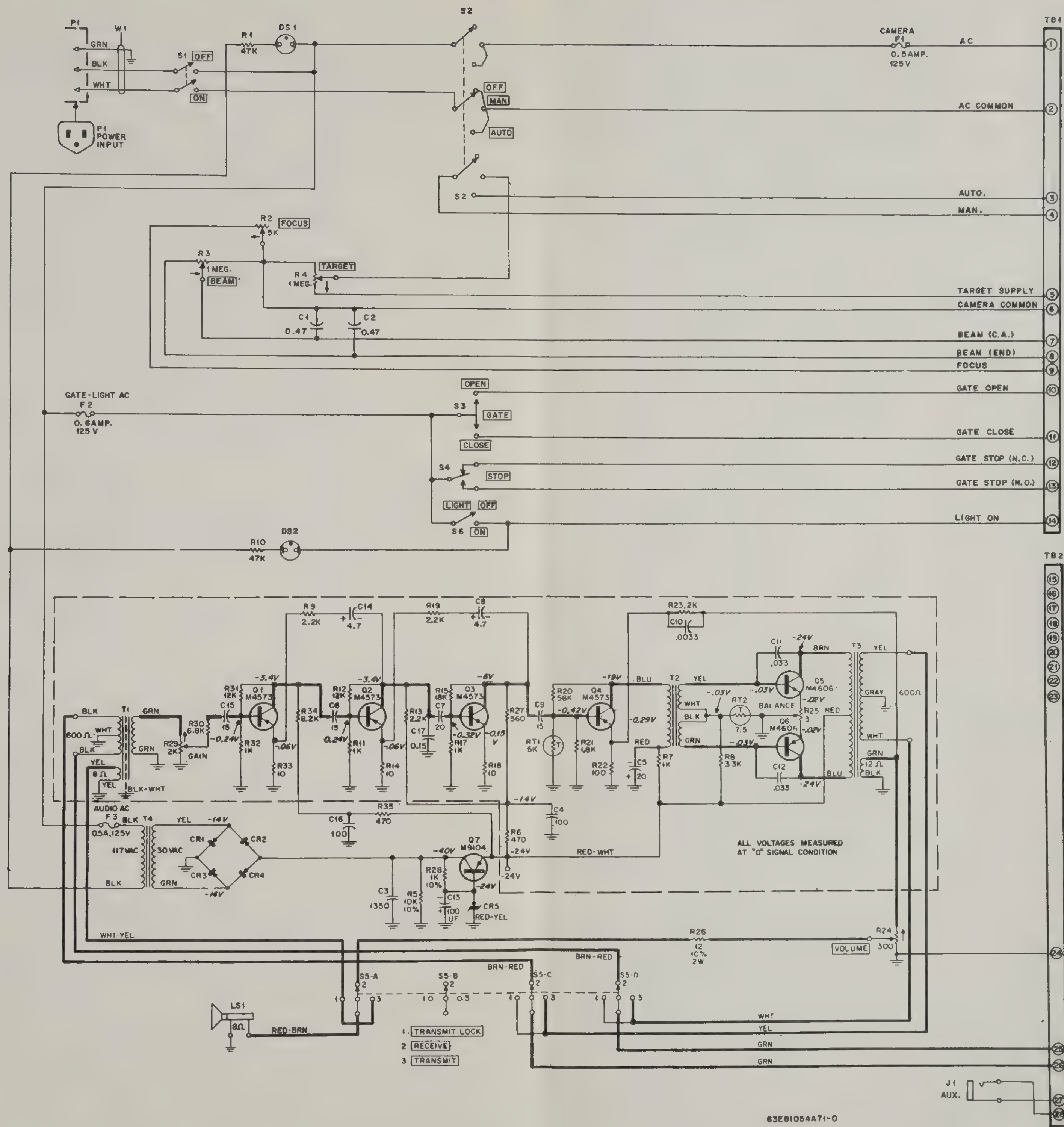
DIRECTION ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION.

MODEL TABLE

DEL	SUFFIX	
6115A		HOUSING KIT
6174A		GATE WATCH CHASSIS

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Model S1239A Gate-Watch
Control Console Schematic Diagram
Motorola No. 63E81054A71-O
6/30/67-UP



NOTES:

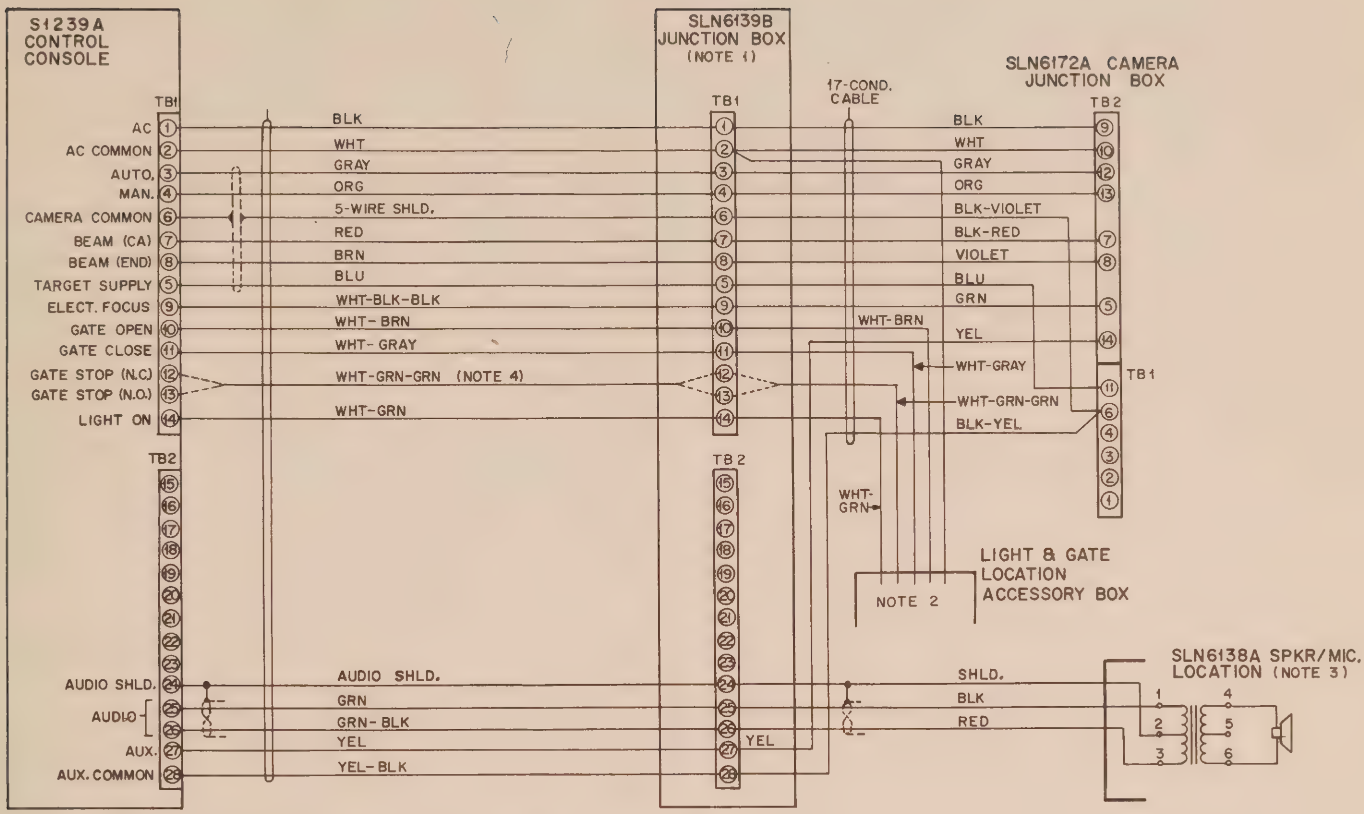
1. ALL RESISTOR VALUES ARE INDICATED IN OHMS, AND ARE ±5%, 1/2WATT UNLESS OTHERWISE STATED. K=1000 OHMS.
2. ALL CAPACITOR VALUES ARE IN MICRO-FARADS UNLESS OTHERWISE STATED.
3. DIRECTION ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION.

MODEL TABLE

MODEL	SUFFIX	
SHN6115A		HOUSING KIT
SLN6174A		GATE WATCH CHASSIS

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model S1239A Gate-Watch
Control Console Schematic Diagram
Motorola No. 63E81054A71-O
6/30/67-UP



NOTES:

1. 25 FEET OF 17 COND. CABLE (30C864650) WITH A SELECTION OF CABLE CLAMPS ARE INCLUDED WITH THE SLN6139B JUNCTION BOX.
2. THESE WIRES ARE NOT SUPPLIED BUT ARE SHOWN TO ILLUSTRATE CONNECTIONS THAT ARE MADE TO AC RELAYS LOCATED IN AN ACCESSORY BOX THAT IS USED TO ACTIVATE LIGHTS AND A VARIETY OF GATE CONTROLS.

   CAUTION

   THESE AC VOLTAGE WIRES ARE INTENDED TO BE USED FOR 100MA RELAY CONTROL ONLY AND SHOULD NEVER BE USED FOR DIRECT CONTROL OF LIGHTS OR GATES.
3. 50 FEET OF 2 COND. CABLE (30B844810) IS INCLUDED WITH SLN6138A SPKR/MIC. UNIT.
4. CONNECT TO TERMINALS 12 OR 13 AS DESIRED.

63C81054A72-A

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A			TB1-5 AND TB1-9 TRANSPOSED	S1239A, SLN6139B

Model S1239A Control Console
System-Interconnection Diagram
Motorola No. 63C81054A72-A
2/28/68-UP

PARTS LIST

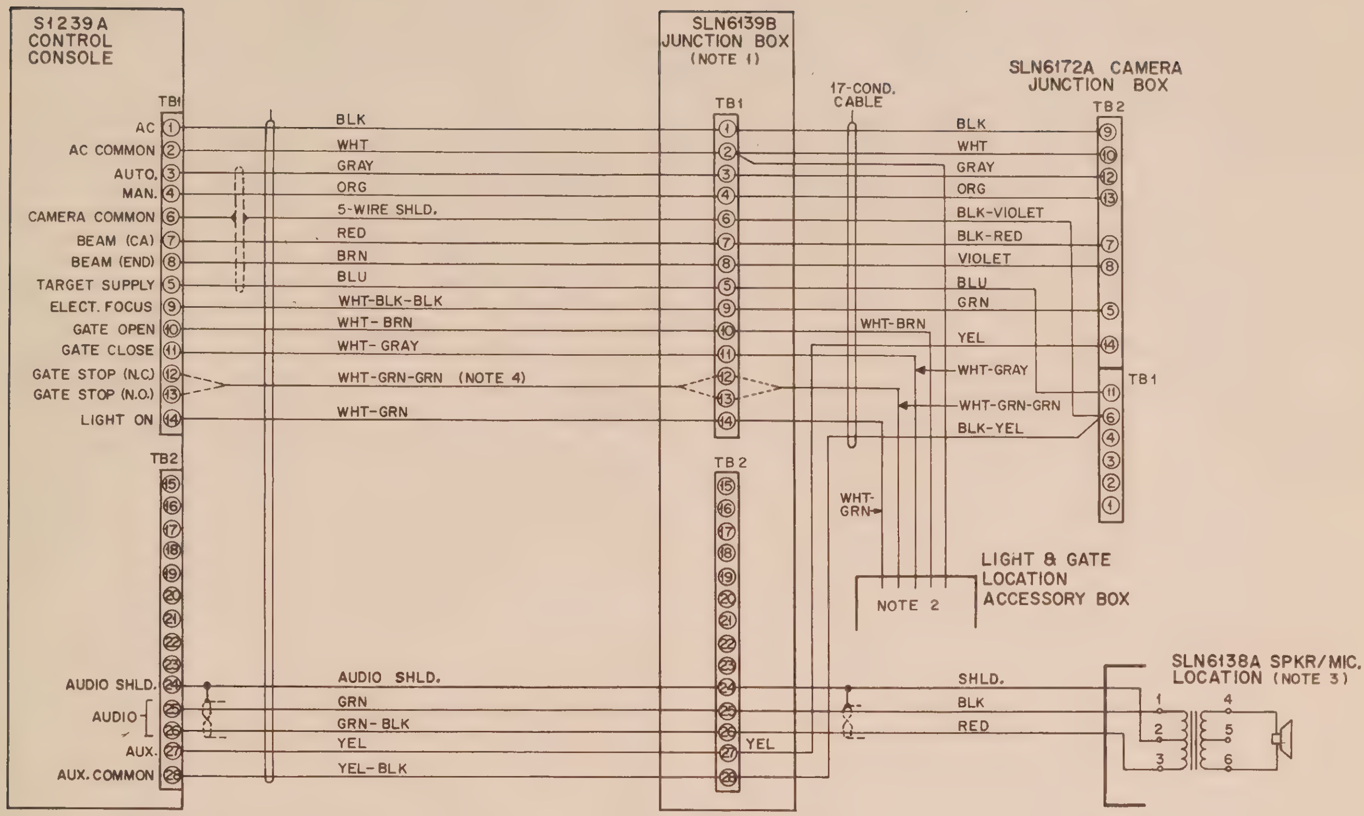
SLN6174A Gate-Watch Chassis — EPD-19526-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf unl stated
C1, 2	8K863994	0.47 ±10%; 200 v
C3	23D82304B06	1350 +100-10%; 50 v
C4, 13, 16	23D82601A01	100 +150-10%; 30 v
C5, 7	23D82601A03	20 +100-0%; 25 v
C6, 9, 15	23D82645A05	15 +100-10%; 25 v
C8, 14	23K865137	4.7 ±20%; 25 v
C10	8K861939	.0033 ±10%; 100 v
C11, 12	8K865640	.033 ±10%; 100 v
C17	8D82905G05	0.15 ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 3, 4	48D82723C01	silicon
	or48C82466H03	silicon
CR5	48D82533D03	zener type (1N3029A)
		LAMP, indicator:
DS1, 2	65A82911C01	neon; RED; incl mtg nut
		FUSE, cartridge:
F1, 3	65K475395	0.5 amp; 125 v; slow-blow type
F2	65K817953	0.6 amp; 125 v; slow-blow type
		JACK, telephone
J1	9B20261	open circuit type
		LOUDSPEAKER, permanent magnet:
LS1	50B82502G01	2-1/2" square; 8 ohm coil
		CONNECTOR, plug:
P1		male; 3 cont (p/o W1)
		TRANSISTOR: P-N-P: (SEE NOTE)
Q1, 2, 3, 4	48R134573	germanium; M4573
Q5, 6	48R134606	germanium; M4606
Q7	48R869104	germanium; M9104
		RESISTOR, fixed: ±5%; 1/2 w unl stated
R1, 10	6S6048	47K ±10%
R2	18C82017F01	var: 5K ±30%; 0.25 w
R3, 4	18C82017F02	var: 1 meg ±30%; 0.2 w
R5	6S6320	10K ±10%
R6, 35	6S400812	470
R7, 11, 17, 32	6S6411	1K
R8	6S2003	3.3K
R9, 13, 19	6S2028	2.2K
R12, 31	6S2075	12K
R14, 18, 33	6S114018	10
R15	6S488095	18K
R20	6S401006	56K
R21	6S400059	1.8K
R22	6S6408	100
R23	6S400060	2K
R24	18D82478B03	var: 300 ±10%; 2 w
R25	18C82943G08	var: 3 ±20%; 2 w
R26	6S118237	12 ±10%; 2 w
R27	6S400058	560
R28	6R6229	1K ±10%
R29	18C82943G07	var: 2K ±20%; 2 w
R30	6S2001	6.8K
R34	6S400490	8.2K
		THERMISTOR:
RT1	6K864780	5.1K ±10% @ 37°C
RT2	6B82430C02	7.5 ±10% @ 25°C
		SWITCH:
S1, 6	40K811752	toggle; dpst
S2	40C82086F01	rotary; 3 pole; 3 position
S3	40B82478G01	toggle; spdt; spring-return to "center off" from both operating positions
S4	40A82286F01	push; spdt, coded "stop"
S5	40C82504G01	rotary; 4 pole 3 position

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		TRANSFORMER, audio frequency:
T1	25C82505G01	contains the following windings: pri: BLK, BLK with WHT center tap; total res 42.5 ±10% sec: GRN, GRN; res 140 ±10% sec: YEL, YEL; res 21 ±10%
T2	25C82506G01	contains the following windings: pri: RED, BLU; res 300 max sec: YEL, WHT; res 5 max sec: BLK, GRN; res 5 max
T3	25C82507G01	contains the following windings: pri: BRN, BLU with RED center tap; total res 5.5 ±10% sec: WHT, YEL with GRAY center tap; total res 29.5 ±10% sec: BLK, GRN; res 0.9 ±10%
		TRANSFORMER, power: 117 v ac; 50-60 cps;
T4	25C82510G01	contains the following windings: pri: BLK, BLK; res 14.3 ±10% sec: GRN, YEL; res 3 ±10%
		BOARD, terminal:
TB101, 102	31K838541	14 terminals
		CABLE ASSEMBLY, power:
W1	30C865903	incl 3 cond cable; rubber covered; each cond No. 18 ga; str; incl "molded on" 3 cont plug (P1) 8 ft long overall; does not incl 42K850862 RETAINER, cable
		FUSEHOLDER:
XF1, 2, 3	9C82083C01	extractor post type; for 1-1/4" x 1/4" fuse
		SOCKET, transistor:
XQ5, 6, 7	9D82673A01	2 cont
	NON-REFERENCED ITEMS	
	36B82629H05	KNOB, control (for R2, R3, R4)
	36B82629H06	KNOB, control (for S2, R24)
	36A55361	KNOB, lever (for S5)
	58B65026A01	ADAPTER, line core
	75A82394C01	FOOT, mounting
	42K850862	RETAINER, cable
	1V80731A07	COVER ASSEMBLY: incl 15B82479G01 COVER, rear 43B82361D01 FASTENER; 2 req'd 43B82361D02 STUD; 2 req'd 33A868207 NAMEPLATE 3A892219 SCREW, one-way slot; 2 req'd

NOTE:

Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.



NOTES:

1. 25 FEET OF 17 COND. CABLE (30C864650) WITH A SELECTION OF CABLE CLAMPS ARE INCLUDED WITH THE SLN6139B JUNCTION BOX.
2. THESE WIRES ARE NOT SUPPLIED BUT ARE SHOWN TO ILLUSTRATE CONNECTIONS THAT ARE MADE TO AC RELAYS LOCATED IN AN ACCESSORY BOX THAT IS USED TO ACTIVATE LIGHTS AND A VARIETY OF GATE CONTROLS.

   CAUTION

   THESE AC VOLTAGE WIRES ARE INTENDED TO BE USED FOR 100MA RELAY CONTROL ONLY AND SHOULD NEVER BE USED FOR DIRECT CONTROL OF LIGHTS OR GATES.
3. 50 FEET OF 2 COND. CABLE (30B844810) IS INCLUDED WITH SLN6138A SPKR/MIC. UNIT.
4. CONNECT TO TERMINALS 12 OR 13 AS DESIRED.

63C81054A72-A

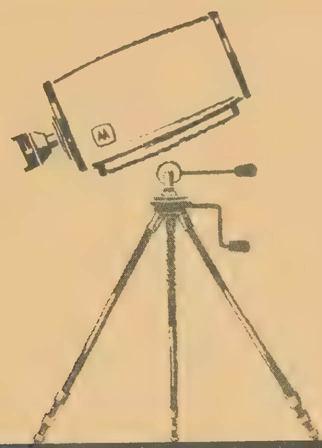
REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A			TB1-5 AND TB1-9 TRANSPOSED	S1239A, SLN6139B

Model S1239A Control Console
System-Interconnection Diagram
Motorola No. 63C81054A72-A
2/28/68-UP

CCTV

MOTOROLA *closed circuit television • area surveillance control console*



MOTOROLA INC., COMMUNICATIONS DIVISION · INSTRUCTION MANUAL

68P81054A65-O

MOTOROLA

AREA SURVEILLANCE CONTROL CONSOLE

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 4501 WEST AUGUSTA BOULEVARD CHICAGO, ILLINOIS 60651

6/27/67-UP

68P81054A65
Issue - O

CONTENTS

GENERAL INFORMATION

1. DESCRIPTION

The Model S1238A Area Surveillance Control Console is a camera control unit. Its primary function is the remote control of a Motorola CCTV camera and any associated equipment, including zoom lens and pan/tilt unit. The Model S1238A can control the camera and its associated equipment at distances up to 3000 feet. While this console has provisions for controlling an elaborate system, as shown on the diagram, it may be used in a limited capacity. This unit can, for instance, be used for controlling only the camera with a fixed focal length lens. In cases where only limited use of console is made, there are provisions for future expansion.

The function of the individual controls is described in the following paragraphs. The SKN6115A Control Cable is used in connecting the camera control unit to the remote equipment shown on the diagram and is described in the Cable Kits Instructions. The Model SLN6172A Camera Junction Unit attached to the rear of camera, is described in the Camera Instruction Manual. A Model SLN6139B Weatherproof Cable Junction Box is recommended for use in this system.

The camera control unit consists of a basic chassis and front panel, enclosed in a rectangular metal housing. The Model S1238A is composed of the following kits:

SLN6173A Zoom Lens and Pan/Tilt Chassis
SHN6115A Housing Kit

The front panel is divided into the following basic remote control groupings:

a. Camera Grouping - Power ON-OFF, OFF-MAN (manual) - AUTO (automatic) and TARGET control.

b. Lens Grouping - ZOOM, IRIS, FOCUS (optical), and speed selector.

c. Pan/Tilt Grouping - Pan/Tilt movement and variable pan/tilt speed.

The rear panel is divided into the following basic remote control groupings:

a. Camera Grouping - BEAM and FOCUS (electrical) control.

b. Auxiliary Grouping - has a wired intercom AUX jack that can be used with sound powered phones.

A ±70 v dc power supply as well as 120 v dc and two variable 90-125 v dc supplies are also located on this basic chassis.

2. SPECIFICATIONS

Application	Depth	Width	Height	Weight
Desk Top	18.50"	15.00"	4.25"	20-3/4
Rack Mounting	18.75"	19.00"	5.22"	26-3/4

Maximum Power Input - 150 WATTS
@ 117 V, 50-60 cps

3. MODEL COMPLEMENT

Application	consists of the follow items:			
	SHN6115A Housing Kit	SLN6173A Zoom Lens and Pan/Tilt Chassis	SLN6137A Rack Mount Adapter	SKN6115A Control Cable
Desk Top	X	X		X
Rack Mounting	X	X	X	X

INSTALLATION PROCEDURE

1. MOUNTING

The Model S1238A Control Console can be conveniently located on a desk top or shelf. The unit may be used as a pedestal for a Motorola 14-inch monitor. If rack mounting of the console is required, the SLN6137A Rack-Mount Adapter Kit must be used. To install the rack-mount adapter kit follow this procedure:

a. Remove the four screws and mounting feet from the console.

b. Place console in adapter.

c. Use removed screws to secure console to the adapter.

d. Mount console and adapter to rack.

2. CONNECTIONS

The rear portion of the control console has two screw-type terminal strips mounted for external cable connection that can be made accessible by removing the snap-on dust cover. Every terminal that is used is numbered as to its function and connections can be conveniently made with the aid of a screwdriver, once the SKN6115A Control Cable is properly dressed. Each terminal connection can be properly made by consulting the Schematic Diagram 63C81054A66. Each color-coded control cable conductor has been assigned a particular function and care should be made to match the proper conductor with the proper stamped circuit function.

The SKN6115A Control Cable meets all the requirements for this particular system. This control cable is used for remote control operation at distances up to 3,000 feet.*

Due to prevailing shock hazards, the snap-on dust cover must be replaced when wiring is completed.

CAUTION

DO NOT PLUG IN CONTROL CONSOLE POWER CORD UNTIL THE ENTIRE SYSTEM HAS BEEN WIRED.

A Model SLN6139B Weatherproof Cable Junction Box is available for distribution of control cables to the remote controlled equipment. The box has terminal boards and each terminal is marked and has an assigned function to facilitate the necessary loop-thru.

*The Lens Speed control is line-compensated and is wired for minimum line length by R5 and R11 to lens power supply (consult Schematic Diagram 63C81054A66. If compensation for longer line lengths is desired, use recommended values on schematic.

OPERATING INSTRUCTIONS

The function and operating instructions for the remote control console are as follows:

1. CAMERA GROUPING

a. ON-OFF Switch

Place switch in the ON position to apply power to control console.

b. FOCUS Control (Electrical)

Adjusts the electrical focus of the camera vidicon tube. Control is located on the rear panel of console.

c. BEAM Control

Adjusts the camera vidicon tube beam current. Control is located on the rear panel of console.

d. OFF-MAN (manual) - AUTO (automatic) and TARGET Control

Applies power to the remotely located camera when placed in MAN or AUTO position. In the AUTO position, target voltage is automatically adjusted by camera circuitry. In the MAN position, target voltage is normally adjusted by the TARGET control.

Refer to the Camera Instruction Manual for the proper setting of these controls.

2. LENS GROUPING

The zoom lens control panel has four switches which are used to control the optical functions of the zoom lens. Three of these are lever action switches and are used for controlling the ZOOM, FOCUS and IRIS. The fourth is a three position rotary switch used to select the speed at which the ZOOM, FOCUS and IRIS are controlled.

Placing the ZOOM switch in the IN position increases the focal length of the lens, thereby decreasing the viewing angle. Holding the switch in the OUT position decreases the focal length, thereby increasing the viewing angle.

The three-position rotary switch serves as a speed control, offering the operator a choice of high speed, medium, or low speed operation for the function of zoom, focus and iris.

The important characteristic of a zoom lens is that its focal length can be continuously varied between the maximum and minimum limits of the lens. Therefore, the operator can, at will, change the focal length from minimum to maximum,

maximum to minimum, or set it for any intermediate focal length. The process of changing focal length is called zooming.

3. ATTACHING THE LENS TO THE CAMERA

a. Loosen the clamp screw in the rear of the lens.

b. Pull out the camera adapter sleeve with the "C" mount thread.

c. Screw this adapter tightly into the camera body.

d. Slide the lens all the way back on the camera adapter sleeve, and position the lens as desired.

e. Tighten the clamp screw slightly so that the lens can still slide forward.

4. ALIGNING LENS FOR PROPER OPERATION

It is advisable to have the camera in the same area as the control console when making the following lens alignment.

a. Train the lens on a stationary object, and turn the ZOOM switch to IN until the largest possible image is shown, which may be blurred.

b. Use the FOCUS switch and the slowest speed on the control panel to bring the object into sharp focus in the telephoto position (largest image).

c. Turn the ZOOM switch to OUT. If the picture lost sharpness as it became small, slide the zoom lens back and forth manually on its adapter sleeve until the picture is sharp again in the wide angle position (smallest image).

d. Repeat Steps 2 and 3 until sharp focus is maintained throughout the entire zoom. Tighten the clamp screw as the lens is now aligned.

e. If you wish to observe other objects at different distances, use only the distance switch for focusing (in the telephoto position).

CAUTION

Do NOT use the focusing adjustment provided on the Vidicon Camera during the alignment procedure described above, or after alignment.

If the image is not sharp over the entire zoom range, check the following points:

(1) Was the lens properly adjusted on the adapter sleeve, or moved during the tightening of the clamp screw?

(2) Was the lens properly focused in the telephoto position? (Distance setting of a zoom lens is always critical in the telephoto position because telephoto lenses have a very shallow depth of field.)

The IRIS control on the zoom panel is used to open or close the lens to compensate for varying light conditions. Placing the IRIS switch in the OPEN position enlarges the iris opening to allow more light to fall on the vidicon face. Conversely, placing the IRIS control in the CLOSE position reduces the iris opening to allow less light to fall on the vidicon face. As with all lenses, the smaller the lens opening, the greater the depth of field.

5. PAN AND TILT GROUPING

a. <u>DIRECTION Control</u>

The Direction control S7 is, in effect, an 8-position switch. Move the control lever off-center to:

(1) Pan left
(2) Pan left and tilt up
(3) Tilt up
(4) Tilt up and pan right
(5) Pan right
(6) Pan right and tilt down
(7) Tilt down
(8) Tilt down and pan left

When the desired scene comes into view, release the control lever to stop the camera.

b. <u>PAN and TILT SPEED Control</u>

Activate the Direction control and rotate the Speed control until the desired speed is attained. The Pan and Tilt may either be speeded up or slowed down in this manner.

THEORY OF OPERATION

1. GENERAL

As shown on the schematic diagram at the back of this manual, the remote controls are either switches, potentiometers or a variable transformer. A functional description of these groupings is explained below:

2. DESCRIPTION

a. Lens Grouping Power Supply

The power supply in the control console is a full-wave rectifier delivering +70 volts and/or -70 volts with reference to a supply common. This voltage is supplied to the dc motors in the automatic lens at the camera site. Dropping resistors are used in all control lines to the controlled units. These serve two purposes: (1) When more than one motor is operated simultaneously, the total load resistance across the power supply is larger than would be otherwise, and (2) The added resistances (dropping resistor) are large compared to the line resistance; therefore, the line resistance is negligible and the power supply generally does not require adjustment for cable lengths up to 3,000 feet.

NOTE

This system has a line-compensation feature to insure optimum performance at the camera location. See Installation Procedure section for details.

b. Pan/Tilt Grouping Power Supplies

The drive voltages for the Pan/Tilt drive motors are supplied by one half-wave and one full-wave rectifier circuits. The half-wave rectifier is a fixed-voltage type that supplies the Pan/Tilt motor fields. The full-wave rectifier is of the variable type 90-125 v dc which supplies the Pan/Tilt armatures.

c. Camera Grouping

(1) ON-OFF Switch

This switch (S1) applies 117 v ac to the control console power supplies.

(2) FOCUS, BEAM, OFF-MAN-AUTO and TARGET Control

These controls have been discussed briefly in the Operating Instructions section. Their operation is also discussed in the Camera Instruction Manual.

d. Lens Grouping

The three controllable functions of the zoom lens (i.e., zoom, focus and iris) are operated by 3.5 v dc motors. The power for the zoom lens is provided by the dc supply in the control console.

Each of the three lever action switches is a single-pole double-throw momentary contact switch with center off. These switches are used for control of ZOOM, FOCUS and IRIS.

A 3-position rotary switch serves as a speed control, offering high, medium and low speed operation.

The three motors which drive the zoom, focus and iris have one of their leads attached to the common power supply return. It is necessary to supply a voltage of the correct polarity to the proper motor to perform the desired operation. The zoom motor increases the focal length of the lens when a positive voltage is applied to it and decreases the focal length of the lens when a negative voltage is applied. A positive voltage applied to the iris motor opens the iris and a negative voltage closes it. To focus the lens on a nearer object, a positive voltage is used and to focus on a more distant object, a negative voltage is applied to the focus motor.

The three functions of zoom, focus and iris can be performed slowly or rapidly as desired by the camera operator. A 3-position speed control switch is provided for this purpose. This switch places resistances in the zoom lens control circuit, decreasing the voltages to the motors.

e. Pan/Tilt Direction Control

A motor driven pan and tilt enables the operator to change the scene being viewed by moving the camera in a horizontal and/or vertical direction. The pan and tilt units used in Motorola Closed Circuit Television installations are driven by dc motors. The dc for these motors is supplied by the pan and tilt power supplies. The motors will operate from 90 to 125 volts. Their speed depends upon the voltage supplied. Speed control is discussed in paragraph "f".

When the ON-OFF switch is placed in the ON position, ac voltages are applied to the pan and tilt power supplies.

The control console chassis supplies two dc voltages to the pan and tilt mechanism. One dc voltage is used to energize the fields of both pan and tilt motors. Another dc voltage supplies the pan motor armature and the tilt motor armature.

The field voltage is rectified directly from the ac line, and remains fixed at about 120 volts dc. In the Motorola variable speed system, the armature supply rectifier is supplied from a variable transformer permitting the rectified output to be varied from 90 to 125 volts.

The pan and tilt direction control switch is, in effect, an eight position switch. The eight functions available to the operator are: (1) pan left, (2) pan left and tilt up, (3) tilt up, (4) tilt up and pan right, (5) pan right, (6) pan right and tilt down, (7) tilt down, (8) tilt down and pan left. There are no detents in this switch. The operator merely places the control lever in the direction in which he desires the camera to move.

f. Pan/Tilt Speed Control

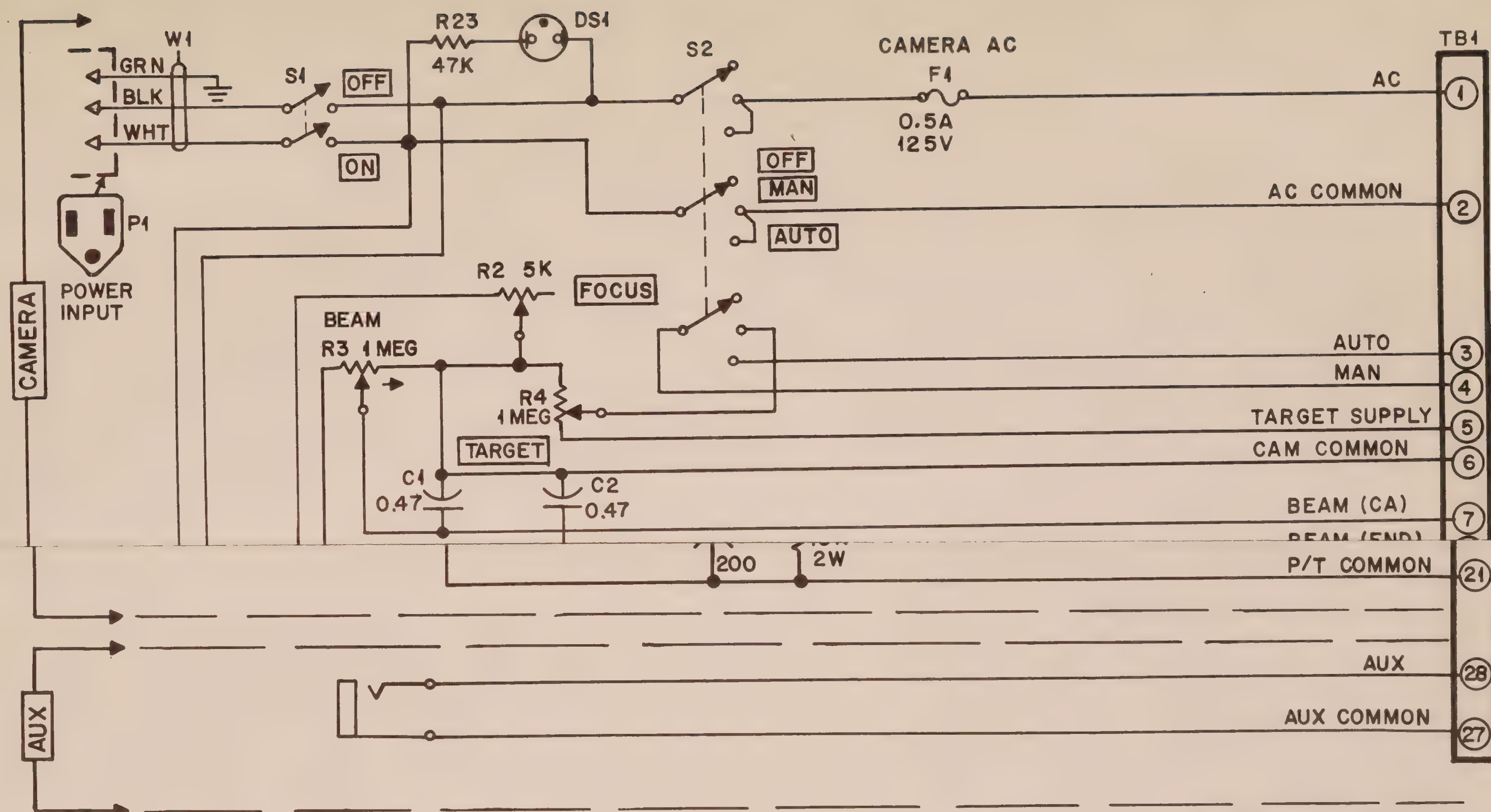
The speed at which the camera is panned or tilted can be changed by the pan speed and tilt speed control. With long focal length lenses, it is desirable to operate the units slowly, enabling a more precise centering of the scene on the monitor. When changing between widely separated scenes, a fast pan rate is desirable.

The pan and tilt drive motors will operate over a voltage range from 90 to 125 volts dc. The higher the voltage, the faster the panning or tilting action.

The speed control device is a manually adjusted variable transformer. When the speed control is rotated in the clockwise direction, it increases the variable transformer output voltage. This increases the dc supply voltage which in turn provides a higher voltage to the pan and tilt motor armatures at the unit causing it to operate at a faster rate. The reverse is true for a counterclockwise rotation.

MAINTENANCE

Maintenance consists of keeping units clean and connections tight. Malfunction of the control facilities can normally be attributed to lack of power. Use the schematic diagram in this manual to locate circuits at fault. In most instances, troubles can be located using only a voltmeter.



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NOTES:

1. ALL RESISTOR VALUES ARE INDICATED IN OHMS AND ARE ± 10%, 1/2WATT UNLESS OTHERWISE STATED. K=1000 OHMS.

2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE STATED.

3. DIRECTION ARROWS ON CONTROLS INDICATE CLOCKWISE DIRECTION.

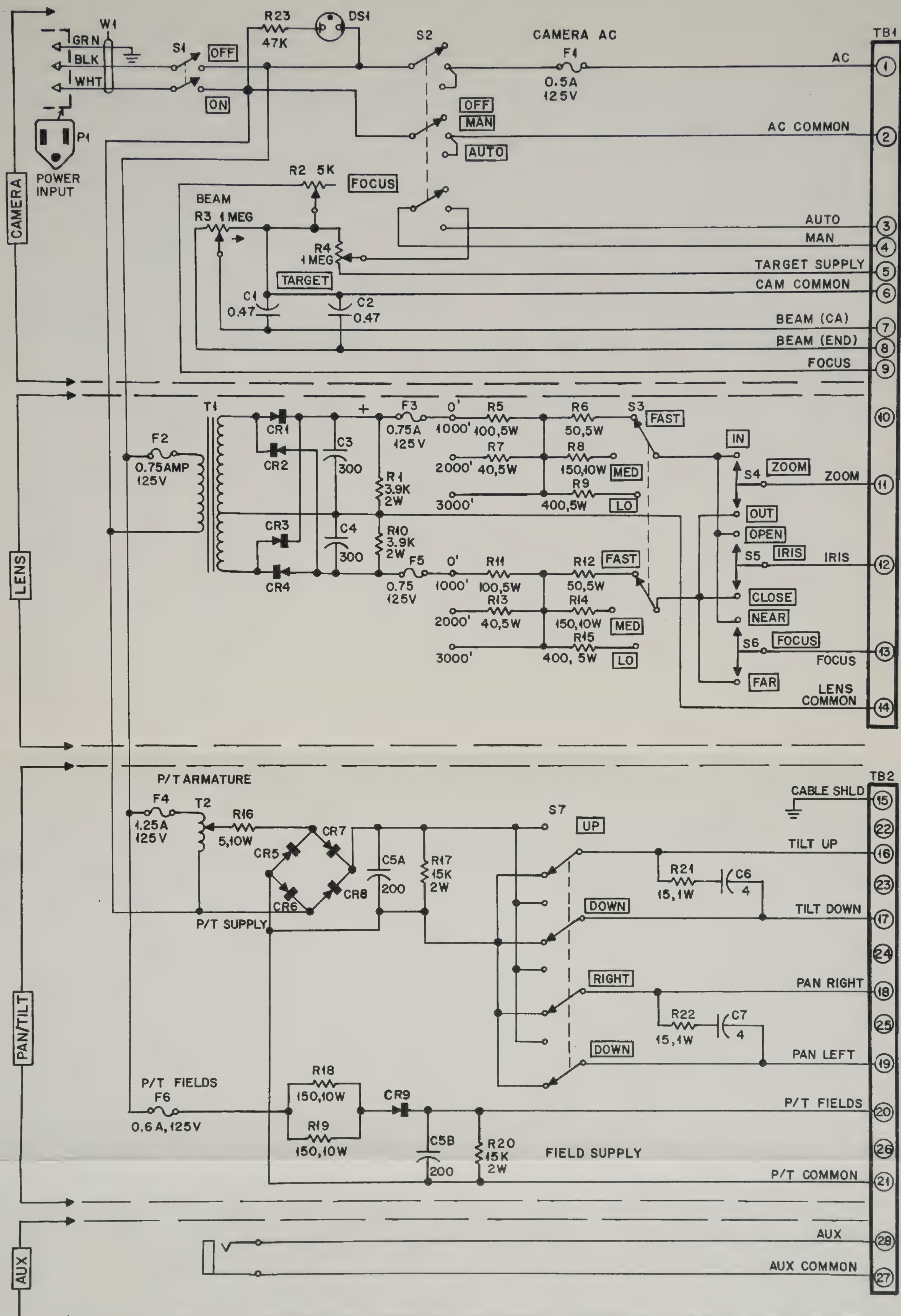
4. P/T=PAN TILT.

MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
SHN6115A		HOUSING KIT
SLN6173A		ZOOM LENS AND PAN/TILT CHASSIS

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model S1238A Control Console
Schematic Diagram
Motorola No. 63C81054A66-O
6/27/67-UP



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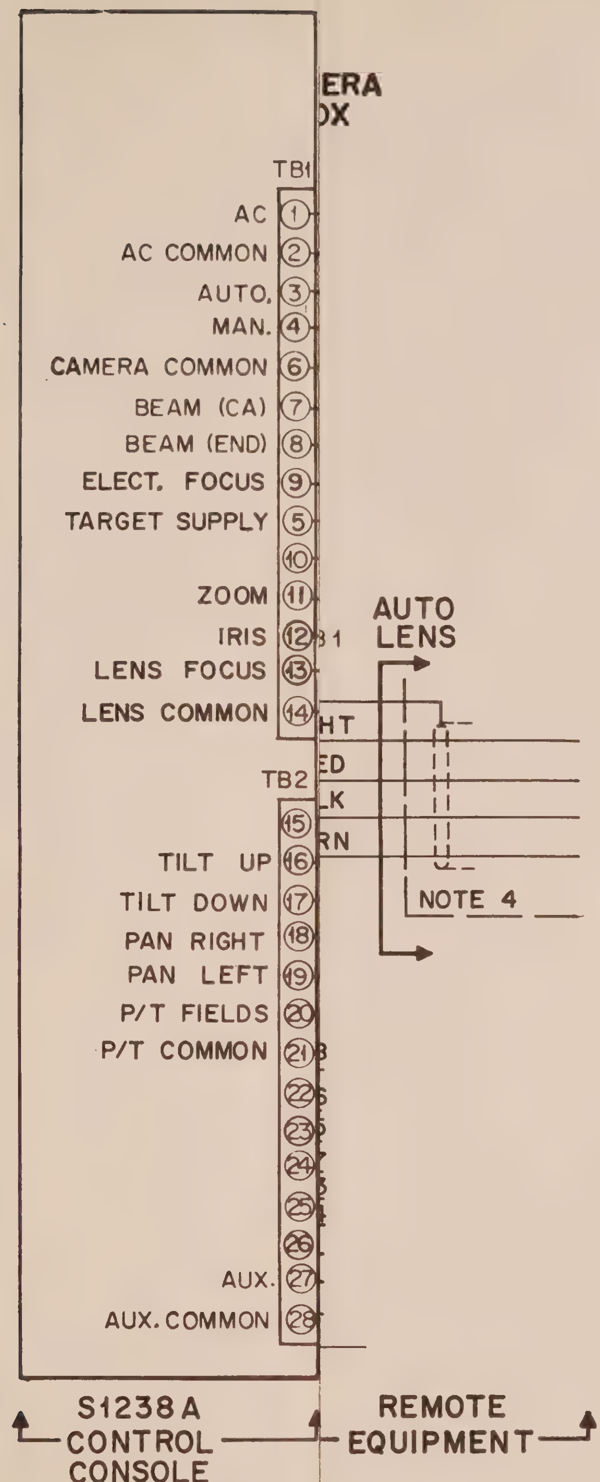


NOTES:
1. P/T =
2. 25FE
CONT
INCLU54A67- 0
3. 25FO
4. 25FO
5. AUTO
THE

Model S1238A Control Console
System-Interconnection Diagram
Motorola No. 63C81054A67-O
6/27/67-UP

PARTS LIST

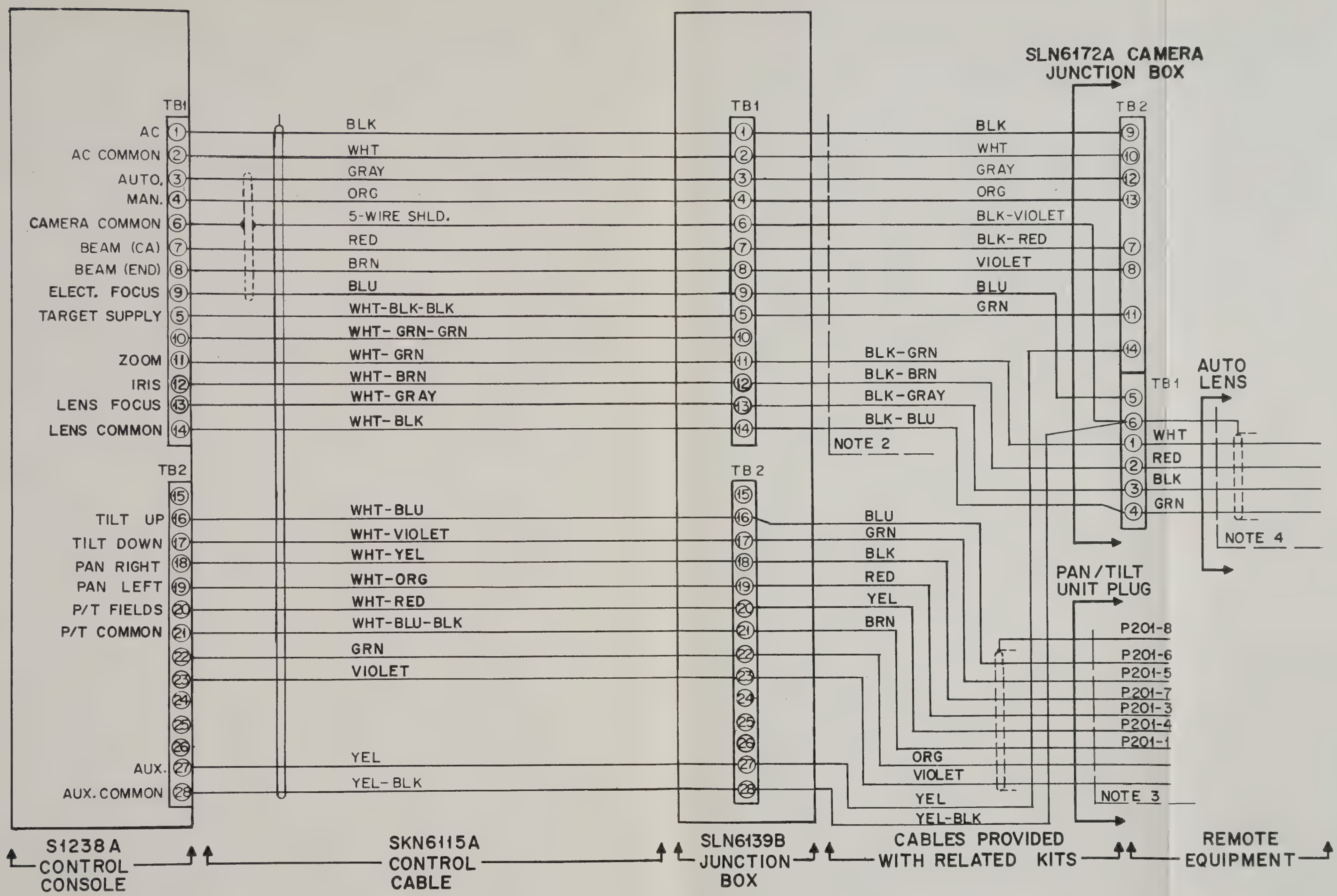
SLN6173A Zoom Camera Control Kit EPD-19495-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf unl stated
C1, 2	8K863994	.47 ±10%; 200 v
C3, 4	23K833408	300 +100-10%; 150 v
C5	23D82125B18	dual section
C5A, 5B		200 +100-10%; 300 v
C6, 7	8K863550	4 ±10%; 200 v
		LAMP, INDICATOR:
DS1	65A82911C01	neon glow lamp: RED; incl mtg nut
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 8	48C82466H02	silicon
CR9	48C82525G06	silicon
		FUSE, cartridge: glass
F1	65K475395	0.5 amp; 125 v; slow-blow type
F2, 3, 5	65K892099	0.75 amp; 125 v; slow-blow type
F4	65K834466	1.25 amp; 125 v; slow-blow type
F6	65K817953	0.6 amp; 125 v; slow-blow type
		JACK, telephone:
J1	9B20261	open circuit type
		CONNECTOR, plug:
P1		male; 3 cont; p/o W1
		RESISTOR, fixed: unl stated
R1, 10	6S476012	3.9K ±10%; 2 w
R2	18C82018F01	var: 5K
R3, 4	18C82018F02	var: 1 meg
R5, 11	17K831332	100 ±10%; 5 w
R6, 12	17K812897	50 ±10%; 5 w
R7, 13	17K474955	40 ±5%; 5 w
R8, 14, 18, 19	17K80566	150 ±10%; 10 w
R9, 15	17C82291B18	400 ±5%; 5 w
R16	17K852448	5 ±5%; 10 w
R17, 20	6S5732	15K ±10%; 2 w
R21, 22	6S118227	15 ±10%; 1 w
R23	6S6048	47K ±10%; 1/2 w
		SWITCH
S1	40K811752	dpst; toggle
S2	40C82086F01	rotary; 3 pole; 3 position
S3	40B82398C01	rotary; 2 pole; 3 position
S4, 5, 6	40B82478G01	toggle spdt; spring-return to "center off" from both operating positions
S7	1V80796A80	BRACKET AND SWITCH ASSY. incl 40C82293F01 SWITCH, snap action; 4 req'd: 7B83430B01 BRACKET, switch mtg. 45A82475G01 ACTUATOR, switch 45B82476G01 LEVER, actuating 41A82477G01 SPRING 4K601456 WASHER "C"
		TRANSFORMER:
T1	25C82468G01	power; pri: BLK, BLK; res: 15 ohms sec: RED, RED with RED-YEL center tap; total res: 9.7 ohms
T2	25C82470G01	AUTO TRANSFORMER, var; input voltage; 120 v ac; 60 cps (term 1-2) output voltage; 60 to 120 v no load, (term 1-3)
		BOARD, terminal:
TB1, 2	31K838541	14 term.
		CABLE:
W1	30C865903	3 cont power cable: incl. ref. P1; does not incl 42K850862 RETAINER, cable
		FUSEHOLDER:
XF1, 2, 3, 4, 5, 6	9C82083C01	extractor post type; incl mtg hdwe.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEMS		
	42K850862	CABLE RETAINER
	75A82394C01	FOOT, mtg
	58B65026A01	ADAPTER, line cord
	1V80731A07	COVER ASSEMBLY: incl 15B82479G01 COVER, rear 43B82361D01 FASTENER: 2 req'd 43B82361D02 STUD; 2 req'd 33A868207 NAMEPLATE 3A892219 SCREW, one-way slot 2 req'd
	36B82629H02	KNOB, control (for S2, S3)
	36B82629H05	KNOB, control (for R2, R3, R4)
	36B82631H04	KNOB, control (for S7)

NOTE:

Replacement diodes must be ordered by Motorola part number only for optimum performance.



NOTES:

1. P/T = PAN/TILT
2. 25 FEET OF RG59B/U (30C827910O1) WITH CONNECTOR & 25 FEET OF 17 COND. CONTROL CABLE (30C864650) WITH A SELECTION OF CABLE CLAMPS ARE INCLUDED WITH THE SLN6139B JUNCTION BOX.
3. 25 FOOT LENGTH OF THIS CABLE SUPPLIED WITH P/T UNIT
4. 25 FOOT LENGTH OF THIS CABLE SUPPLIED WITH AUTOMATIC LENS UNIT.
5. AUTO LENS CABLE SHIELD TO BE CONNECTED TO TB1-6 TERMINAL IN THE SLN6156A UNIT.

63C81054A67-O

Model S1238A Control Console
System-Interconnection Diagram
Motorola No. 63C81054A67-O
6/27/67-UP

CCTV Control Console

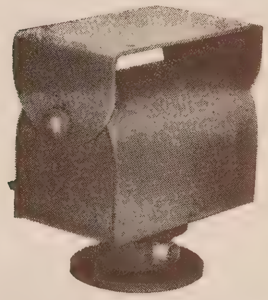
68P81054A65-O

REMOTE CONTROL PAN-AND-TILT UNITS

FEATURES

- **Smooth, Quiet Operation for Best Picture Stability**
- **Ruggedly Constructed Aluminum Housings for Long-Term Protection**
- **Capable of 350° Pan and ±90° Tilt for Extended Area Coverage**
- **Variable Speed Pan and Tilt for Added Versatility**
- **Environmental Units Available in Weather and Explosion Proof Models**
- **Explosion Proof Model Certified to Military Specs**

Indoor Camera Pan and Tilt Assessory,
Model VSP-020-42



Environmental Camera Pan
and Tilt Accessory,
Weather-proof Model VSP-020-40
Explosion-proof Model VSP-020-41

MOTOROLA PAN AND TILT UNITS PROVIDE:

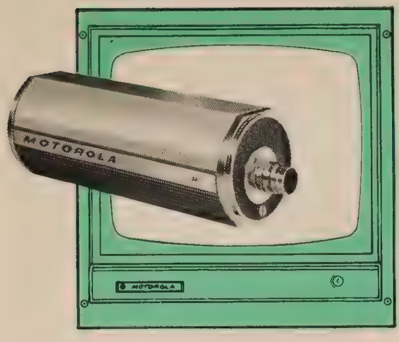
EXCELLENT OPERATIONAL RELIABILITY—Precision engineered construction assures smooth, quiet operation with maximum stability and minimum backlash for best picture stability.

EASE OF OPERATION — Both pan and tilt directional movements are under full remote control of a single "joystick" lever. Electrical, dynamic braking assures instant, accurate response as direction of movement is changed. Speed of movement is varied remotely by a single control.

EXACT MODEL FOR NEEDS — The Full Motorola line enables selection of the precise unit for your installation, even when used in explosive atmospheres or exposed to weather. Meets MIL-E-5272C explosion proof specifications.

LONG TERM RELIABLE PERFORMANCE — Precise gear design and assembly, heavy duty industrial shunt-type motors, and rugged aluminum housings assure excellent long-term operation.

E-489C



MOTOROLA

CLOSED-CIRCUIT TELEVISION

800 LINE RESOLUTION, COMPACT 27″ VIDEO MONITOR

Motorola video monitors are designed to operate specifically with Motorola cameras to provide "rock-solid" pictures with optimum contrast and detail resolution. They are conservatively designed to provide stable continuous-duty operation without the necessity of frequent control readjustment.

OPTIONAL TRUNNION MOUNT: Can be adjusted for ceiling, wall or shelf mounting, with the monitor tilted or turned for best viewing angle and elimination of potential reflections.

SUPERIOR PICTURE QUALITY—800 lines of horizontal resolution for exceptional sharpness, and 22,000 volts of picture power provide a bright, high-contrast picture. The Motorola Dynamic Focusing Circuit provides a time-varying electrostatic focusing field that maintains optimum edge and corner resolution.

GLAREPROOF — An etched and tinted safety shield is bonded to the picture tube to virtually eliminate glare and reflections, and provide a much clearer picture in highly lighted areas than with a monitor incorporating a separate, polarized safety plate.

ATTRACTIVELY STYLED — The short-neck 110 degree picture tube enables a compact design with weight and size significantly less than other 27″ video monitors. All controls are recessed in the front of the cabinet, concealed behind a hinged panel. The attractively styled cabinet is painted with a light beige baked enamel, and accented by a satin-finished front trim of anodized aluminum.

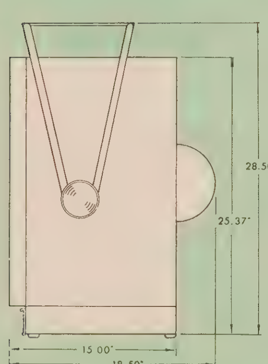
SIMPLE INSTALLATION — The monitor is shipped completely assembled with the picture tube fastened in place by a rugged steel band to withstand vibration and shock.

EASY, SAFE MAINTENANCE — The bonded safety shield minimizes dangers of implosion during routine maintenance, and the picture tube face can easily be wiped clean without removing and cleaning a separate glass. The lower portion of the two-part rear cover can be removed for service while the top section remains in place to protect the neck of the picture tube against accidental breakage. For further ease of maintenance, the bottom of the cabinet is removable for access to chassis components.

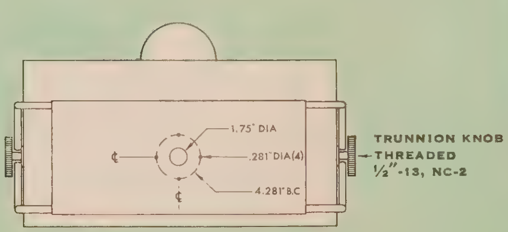
HIGH RELIABILITY — Rugged, carefully selected, quality components, used in conservatively designed circuits, maintain picture quality despite normal loss in tube efficiency with time.

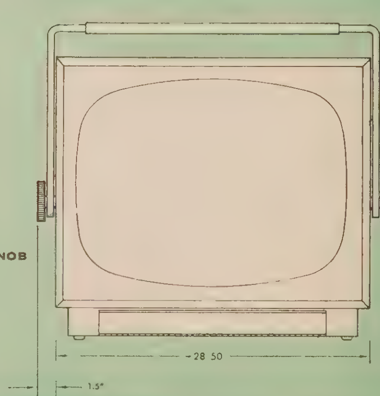
GUARANTEED PERFORMANCE SPECIFICATIONS

VIDEO INPUT (Black Negative Polarity)	0.25 V (p-p) minimum 4.0 V (p-p) maximum
IMPEDANCE	High input impedance for bridging multiple monitors on a cable. Terminating switch provides 75 ohms termination.
INPUT CONNECTORS	UHF
PICTURE TUBE	27″ diagonal (type 27AGP4)
HORIZONTAL RESOLUTION	800 Lines
LINE VOLTAGE	117 VAC ±10%; 60 cps
POWER CONSUMPTION	140 Watts
D-C RESTORATION	In-out switch
OPERATING TEMPERATURE RANGE	0°F to +122°F ambient
CONTROLS (Behind Front Panel)	Brightness, On-Off, horizontal hold, horizontal drive, horizontal size, focus, vertical linearity, vertical size, vertical hold, contrast.
WEIGHT Monitor Model S1127A (without Trunnion Mount):	Net weight; 120 lbs. Shipping weight; 135 lbs.
Trunnion Mount Model SLN6119A	Net weight; 17 lbs. Shipping weight; 20 lbs.
FINISH	Cabinet and Trunnion: Haze beige, bonderized baked enamel; Picture Tube Mask: Mist gray; Front Trim: Satin-finished anodized aluminum.



Trunnion attaches to standard 2-inch plumber's pipe flange.





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E489C
(Replaces E-489B)

SOLID-STATE 9-INCH VIDEO MONITOR

SOLID-STATE RELIABILITY

The 9-inch video monitor is completely transistorized with the exception of the picture tube and high voltage rectifier. Transistorization assures low power drain, minimum heat, small size, light weight, and improved reliability. This unit is conservatively designed to provide continuous duty operation without the necessity for frequent control adjustment.

FEATURES

SUPERIOR PICTURE QUALITY—A 10MHz video response and the excellent geometry and small spot size of the picture tube assure crisp 800 line horizontal resolution for maximum picture detail.

REGULATED PERFORMANCE—Regulation of the low and high voltage power supplies eliminates picture bounce due to rapid line voltage changes inherent in industrial applications. Extremely stable pictures are obtained over a range of 100 to 130 volts.

EASE OF OPERATION AND MAINTENANCE — A switch is provided to permit selection of either 100% dc restoration, to eliminate picture shading in single camera installations, or zero dc restoration, to eliminate variations in brightness in multiple camera installations. Loop-through operation is provided through parallel receptacles allowing multiple monitors to be operated from a single cable run. Adjustment of the raster size from the front of the monitor to simultaneously show all four corners enables this unit to be used as a "test" instrument for maintenance of cameras. For ease in cleaning, a safety shield is laminated on the picture tube. This eliminates the need for a separate dirt-collecting safety glass.

PORTABLE — The cabinet model (with carrying handle) shown above weighs only 34 pounds and measures only 9⅞″ x 9$^{15}/_{16}$″ x 15$^{15}/_{16}$″ making the unit truly portable. This allows you to easily move the monitor for viewing at different locations.

FLEXIBILITY OF APPLICATION—In addition to the portable case, the monitor is also available in rack mount versions (see dimensional drawings on reverse side). The compact chassis size allows two monitors to be mounted side by side in a standard 19-inch relay rack requiring only 8¾″ of vertical space.

SEE REVERSE SIDE FOR DETAILED TECHNICAL DATA

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GUARANTEED PERFORMANCE SPECIFICATIONS

Input Power: 65 watts at 117/234 volts 60 cycles (525/60 U.S.) or 50 cycles (625/50 CCIR). All performance specifications will be met while the line voltage varies from 100 to 130 volts AC at any rate. 3-wire line cord, 6′ long.

Video Signal: 0.3 volt pp minimum. Sync negative at monitor input.

Impedance: High input impedance for bridging multiple monitors on cable. Terminating switch on rear apron provides 75 ohm termination.

Video Response: 10 MHz.

DC Restoration: 100% or zero.

Linearity: Within 2% of picture height.

Primary Controls: (Behind Front Panel) Off-on switch, horizontal hold, vertical hold, height, vertical linearity, contrast brightness, width, focus.

Secondary Controls: (On Rear Apron) Sync selector switch, video line termination switch, AC line fuse.

Chassis Controls: Vertical linearity, vertical hold range, DC restorer switch, high voltage regulator adjustment, horizontal linearity.

Input Connectors: UHF type.

Transistors and Tubes: 28 transistors and 25 diodes on glass epoxy circuit boards. 1B3/1G3-high voltage rectifier. 9SP4—9″ picture tube with laminated safety shield.

MECHANICAL SPECIFICATIONS

Model No.	*Description*	*Width*	*Height*	*Depth*	*Net Weight*	*Shipping Weight*
RNC9/C	Portable Cabinet Monitor	9⅞″	9 15/16″*	15 15/16″	34#	46#
RNC9/2R	Two Monitors, Rack Mounted	19″	8¾″	15 1/16″**	46#	61#
RNC9/RBL	Rack-Mounted Monitor on right, blank left panel.	19″	8¾″	15 1/16″**	29#	41#
RNC9/RBR	Rack-Mounted Monitor on left, blank right panel.	19″	8¾″	15 1/16″**	29#	41#

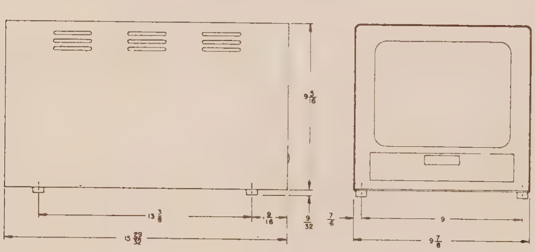
Racks and cabinets are constructed of heavy gauge steel and finished in deep umber gray.

*Does not include mounting feet.

**To mounting surface, front panel 5/16″.

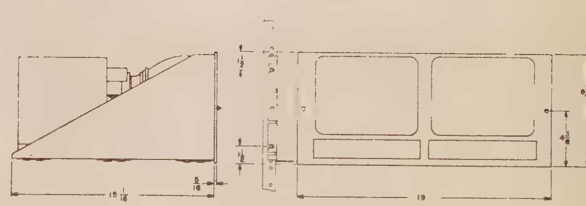
DIMENSIONS

CABINET MODEL



RNC9/C

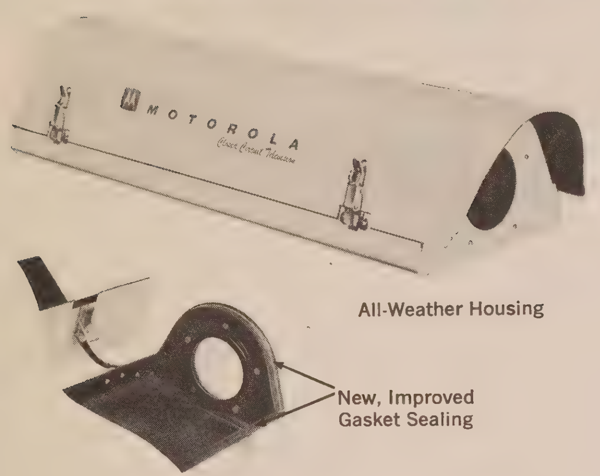
DUAL RACK-MOUNTED MODEL



RNC9/2R

Monitors manufactured by Conrac.

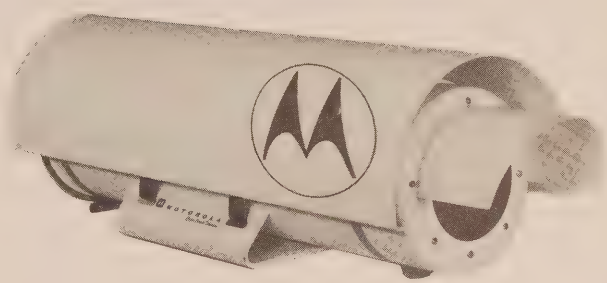
ENVIRONMENTAL CAMERA HOUSINGS



All-Weather Housing


Dust-Tight Housing


Explosionproof Housing


Dust-Tight Housing
with Sun Shroud

ALL-WEATHER HOUSING

The Motorola All-Weather Housing provides complete protection from rain and snow. With the new, improved gasket sealing, even a driving rain cannot penetrate the housing. • The Motorola S/40 camera, itself, operates over an ambient temperature range of −22°F to +140°F *without* troublesome blowers, filters, heaters, or thermostats. • Low height and sloping sides minimize vibration of the picture from wind loading. • If necessary, the housing can be made tamperproof by padlocking the latches. • Plastic covered chains restrain the cover during installation and maintenance.

DUST-TIGHT HOUSING

Constructed of either aluminum alloy or stainless steel, Motorola Dust-Tight Housings are designed for use in dusty, dirty industrial atmospheres. The dust-tight construction contributes to greater reliability and reduced maintenance by prohibiting dirt and foreign particles in the air, including conductive matter, from settling on the components and circuitry. • All units are supplied with a visor for protection from the sun, snow, or rain in outside installations and from overhead lights in inside installations. • A sun shroud is also available and should be used for outside applications to shield the housing from direct solar radiation. It is mounted above the housing to provide air circulation for removal of solar heat. • The stainless steel housing is recommended for use in high temperature environments and corrosive atmospheres. • The housings mount on a cradle with two stainless steel bands. This allows them to be rotated and adjusted longitudinally for balancing the weight of the complete installation.

EXPLOSIONPROOF HOUSING

The Motorola Explosionproof Camera Housing, constructed of aluminum alloy, is structurally designed to contain an explosion and has been tested and certified by an independent testing laboratory to MIL-E-5272C explosion specifications. • The front plate assembly is equipped with a thick plate glass window. • The housing mounts on a cradle with two stainless steel bands. This allows it to be rotated and adjusted longitudinally for balancing the weight of the complete installation.

SEE REVERSE SIDE FOR DETAILED TECHNICAL DATA

MODEL IDENTIFICATION

SHN6112A—All-Weather Housing
VSP-4220—Dust-Tight, Aluminum Alloy, with visor
VSP-4221—Dust-Tight, Stainless Steel, with visor
VSP-4222—Sun Shroud for Dust-Tight Housings
SDN6117A—Explosionproof Housing

SPECIFICATIONS

SHN6112A—All-Weather Housing
- Mounting: See drawing below
- Weight: 17 lbs.
- Finish: White enamel
- Dimensions: L-31 1/16″, H-6″, W-9″

VSP-4220—Dust-Tight, Aluminum Alloy
- Mounting: Cradle and stainless steel bands supplied with each housing.
- Weight: 13 lbs.*
- Finish: White enamel
- Dimensions: L-29″, Dia. 7¾″*

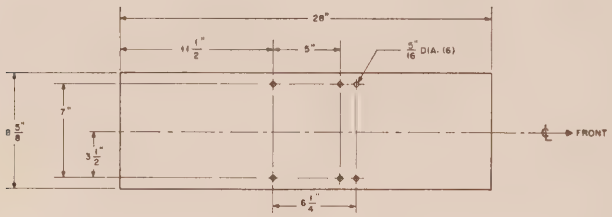
VSP-4221—Dust-Tight, Stainless Steel
- Mounting: Cradle and stainless steel bands supplied with each housing.
- Wt. 17 lbs.*
- Finish: White enamel
- Dimensions: L-29″, Dia. 7¾″*

SDN6117A—Explosionproof Housing
- Mounting: Cradle and stainless steel bands supplied with each housing.
- Weight: 25 lbs.
- Finish: White enamel
- Dimensions: L-25⅛″, Dia. 7⅝″

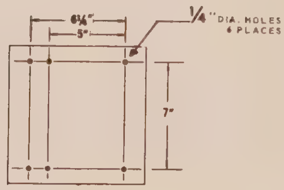
*With sun shroud add 4 lbs. to weight and 1¼″ to height.

Specifications subject to change without notice.

BASE MOUNTING DETAIL



All-Weather Housing



Explosionproof Housing
Dust-Tight Housings

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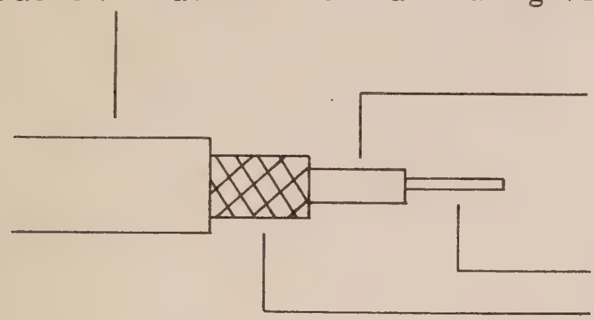
SKN6111A RG59B/U COAX CABLE



SPECIFICATIONS

Temperature Range:	$-30^{\circ}C$ to $+75^{\circ}C$
Minimum Bending Radius:	2.5 inches
Outside Diameter:	.265 inches
Weight Per 1000 Feet:	36 pounds
Maximum Cable Footage Per Reel:	1000 feet
Nominal Impedance:	75 ohms
Nominal Capacitance:	20.5 mmfd per foot
Dielectric Strength:	5000 V RMS 60 cps
Maximum Attenuation:	1.0 db/100 foot @ 10 mc

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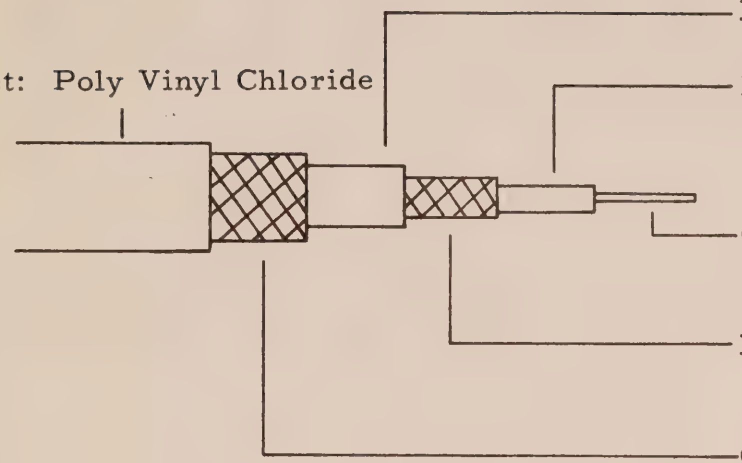
SKN6112A COAX CABLE



SPECIFICATIONS

Temperature Range:	-30°C to +75°C
Minimum Bending Radius:	4. 75 inches
Outside Diameter:	. 500 inches
Weight Per 1000 Feet:	160 pounds
Maximum Cable Footage Per Reel:	2000 feet
Nominal Impedance:	75 ohms
Nominal Capacitance:	17. 3 mmfd per foot
Dielectric Strength:	5000 V RMS, 60 cps
Maximum Attenuation:	. 45 db/100 feet @10 mc

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TIC-3041A

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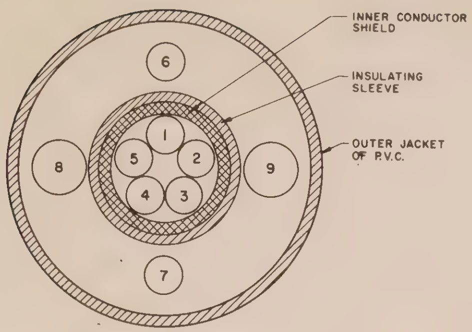
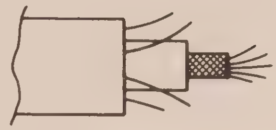
SKN6113A CONTROL CABLE





Conductor #	Function	Color	Gauge
1	Beam (End)	Brn	#20
2	Beam (C. A.)	Red	#20
3	Target (Man.)	Org	#20
4	Target (Auto)	Gray	#20
5	Target Supply	Lt. Blu	#20
Inner Shld. Camera Common			
6	Elect. Focus	Yel	#20
7	Spare	Yel-Blk	#20
8	AC	Blk	#16
9	AC Com	Wht	#16

SPECIFICATIONS

Temperature Range:	-40°C to 90°C
Minimum Bending Radius:	5.4 Inches
Outside Diameter:	.600 Inches
Weight Per 1000 Feet:	191 Pounds
Maximum Cable Footage Per Reel:	2000 Feet

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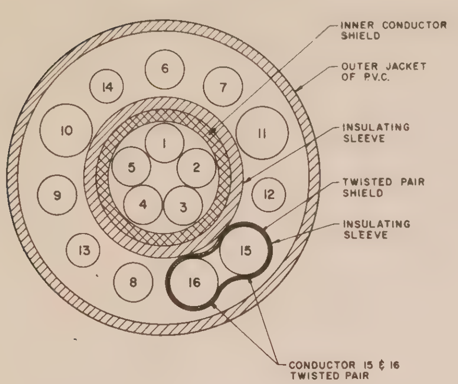
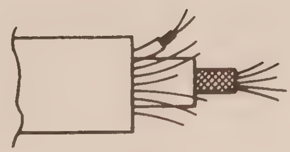
SKN6114A CONTROL CABLE





Conductor #	Function	Color	Gauge
1	Beam (End)	Brn	#20
2	Beam (C. A.)	Red	#20
3	Target (Manual)	Org	#20
4	Target (Auto)	Gray	#20
5	Target Supply	Lt. Blu	#20
5-Wire Shld. Camera Common			
6	Aux.	Yel	#20
7	Aux.	Yel-Blk	#20
8	Elect. Focus	Wht-Blk-Blk	#20
9	Gate Stop	Wht-Grn-Grn	#20
10	AC	Blk	#16
11	AC Com	Wht	#16
12	Light On/Off	Wht-Grn	#22
13	Gate-Open	Wht-Brn	#22
14	Gate-Close	Wht-Gray	#22
15	Gate-Audio	Grn	#18
16	Gate-Audio	Grn-Blk	#18
	Gate-Audio Shld.		

SPECIFICATIONS

Temperature Range:	-40°C to 90°C
Minimum Bending Radius:	6.0 Inches
Outside Diameter:	.635 Inches
Weight Per 1000 Feet:	220 Pounds
Maximum Cable Footage Per Reel:	2000 Feet

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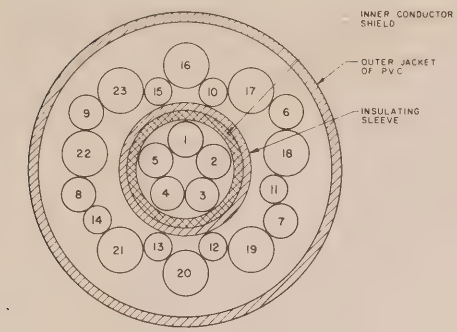
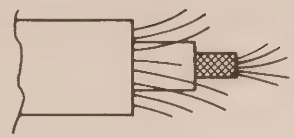
SKN6115A CONTROL CABLE





Conductor #	Function	Color	Gauge
1	Beam (End)	Brn	#20
2	Beam (C. A.)	Red	#20
3	Target (Man)	Org	#20
4	Target (Auto)	Gray	#20
5	Target Supply	Lt. Blu	#20
5-Wire Shld. Camera Common			
6	Aux.	Yel	#20
7	Aux. Com	Yel-Blk	#20
8	Elect. Focus	Wht-Blk-Blk	#20
9	Spare	Wht-Grn-Grn	#20
10	Zoom	Wht-Grn	#22
11	Iris	Wht-Brn	#22
12	Lens Focus	Wht-Gray	#22
13	Lens Common	Wht-Blk	#22
14	Spare	Grn	#22
15	Spare	Violet	#22
18	AC	Blk	#16
16	AC Common	Wht	#16
17	P/T Common	Wht- Blu-Blu	#16
19	Tilt Up	Wht-Blu	#16
20	Tilt Down	Wht-Violet	#16
21	Pan Right	Wht-Yel	#16
22	Pan Left	Wht-Org	#16
23	P/T Fields	Wht-Red	#16

SPECIFICATIONS

Temperature Range:	-40°C to 90°C
Minimum Bending Radius:	6.5 Inches
Outside Diameter:	.675 Inches
Weight Per 1000 Feet:	298 Pounds
Maximum Cable Footage Per Reel:	2000 Feet

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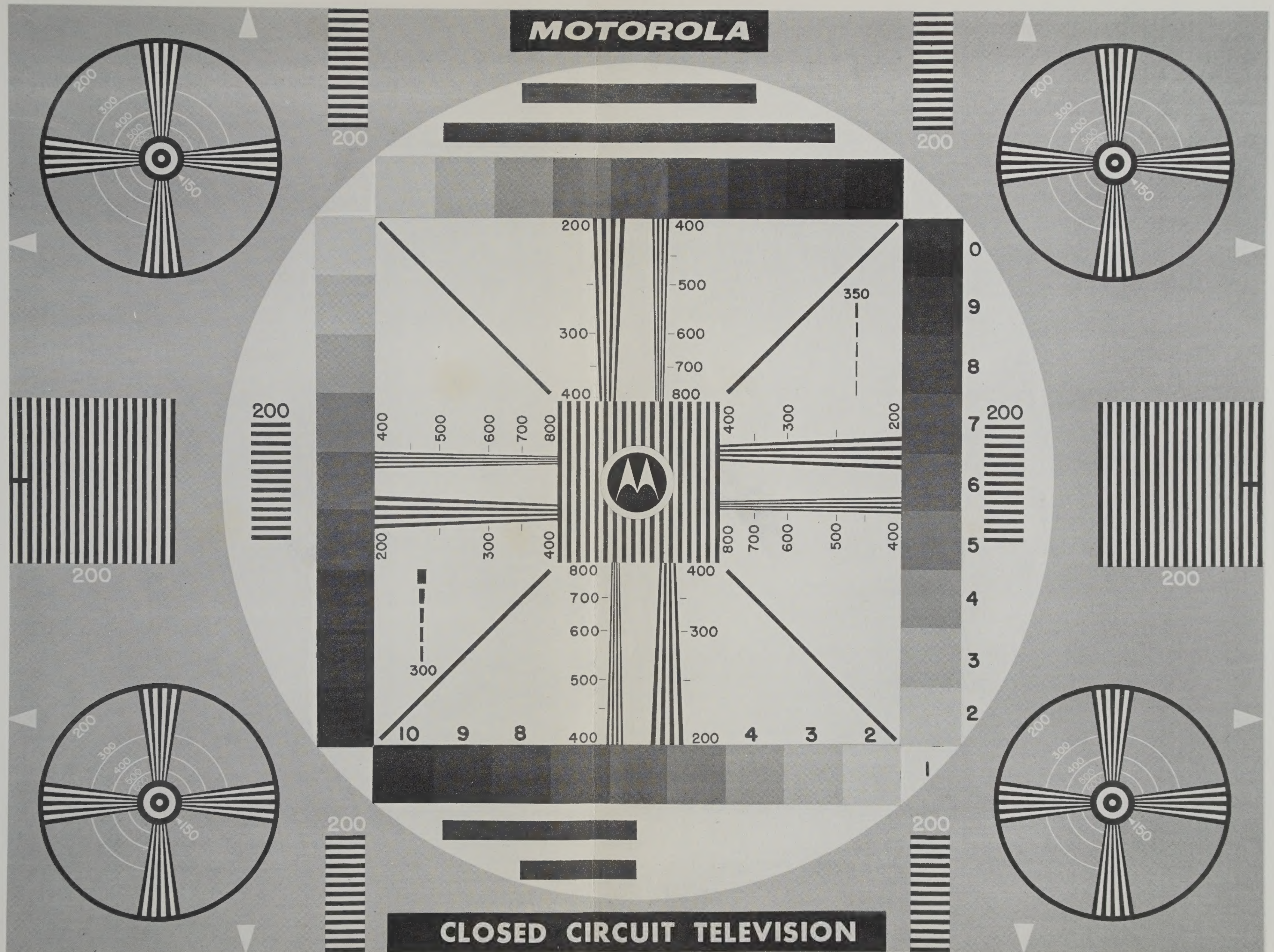
MOTOROLA
CLOSED CIRCUIT TELEVISION